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A TREATISE

ON

PHARMACY:

DESIGNED AS A

TEXT-BOOK FOR THE STUDENT,

AND AS A

GUIDE FOR THE PHYSICIAN AND PHARMACIST,

CONTAINING THE

OFFICINAL AND MANY UNOFFICINAL FORMULAS,

AND NUMEROUS

EXAMPLES OF EXTEMPORANEOUS PRESCRIPTIONS.

BY

EDWARD PARRISH,

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MEMBER OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA; AND OF THE
AMERICAN PHARMACEUTICAL ASSOCIATION.

FOURTH EDITION,

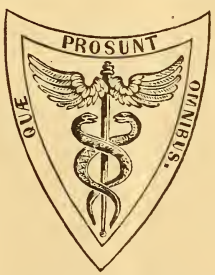
ENLARGED AND THOROUGHLY REVISED

BY

THOS. S. WIEGAND,

GRADUATE OF THE PHILADELPHIA COLLEGE OF PHARMACY.

WITH TWO HUNDRED AND EIGHTY ILLUSTRATIONS



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TO

WILLIAM PROCTER, Jr.,

PROFESSOR OF THEORY AND PRACTICE OF PHARMACY IN THE PHILADELPHIA COLLEGE OF PHARMACY,
EDITOR OF THE AMERICAN JOURNAL OF PHARMACY, ETC.,

This Work is Inscribed

AS A TESTIMONIAL TO HIS ZEAL AND ABILITY

IN

PROSECUTING THE ART AND SCIENCE OF PHARMACY,

AND AS A

TRIBUTE OF THE ENDURING FRIENDSHIP AND ESTEEM

OF

THE AUTHOR.

PREFACE TO THE FOURTH EDITION.

When the sudden and lamented death of Mr. Parrish occurred, in September, 1872, he had for some time been engaged in making preparations for a new edition of his Treatise on Pharmacy, in anticipation of the revised *U. S. Pharmacopœia.* Stricken down while in the zealous discharge of his duties as a peace commissioner to the Indians, his papers were placed in the hands of the editor, who has endeavored to carry out the views of his deceased friend in so far as they were indicated by the MS. and notes which he left behind.

Among the changes thus introduced will be observed an alteration in the general arrangement of the work. Part I. has been almost entirely rewritten, embodying new topics and some which were formerly in other portions of the volume. Part II. has also been much altered, and the order of the remaining divisions has been changed.

The position which the work has assumed as a leading authority on Pharmacy, and the knowledge that the author had devoted to it so large a portion of the labors of an active and useful life, have made the editor realize fully the responsibility incurred in its revision. This responsibility he has endeavored to discharge conscientiously, regardless of the labor which it involved. During the ten years which have elapsed since the appearance of the last edition, the advance of pharmaceutical science has been marked, and it has been his endeavor to introduce whatever of value has been developed by the investigations and improvements made during that period. In adapting the work, moreover, to the new edition of our

national *Pharmacopœia* it became necessary not only to observe the changes in the list of preparations but to revise the nomenclature. The new notation of chemical substances has likewise been introduced, involving a very laborious revision of all the chemical formulas.

These changes and additions have increased the size of the volume by about one hundred and fifty pages, notwithstanding the care with which all matter that could be considered obsolete has been omitted. It has been the object of the editor throughout to preserve strictly the practical and useful character of the work, and he hopes that it may be found not unworthy a continuance of the confidence which has hitherto been bestowed upon it.

The use of syllabi in the scientific portions of the work has been continued, as designed by the author, experience having still further confirmed his impressions as to their advantage in displaying, in a condensed shape, all important facts connected with the substances described. In alluding to these syllabi it is proper to refer to the author's acknowledgment, in his previous edition, of the valuable assistance rendered by Prof. J. M. Maisch in their preparation.

If it had been possible by any typographical arrangement to make a distinction between the new matter and the old, the editor would gladly have done so. The changes, however, have been so numerous and pervade the text so thoroughly that no system could be adopted for this purpose without distracting the attention of the reader to a degree that would be inadmissible.

PHILADELPHIA, March, 1874.

HINTS

TOWARD THE

STUDY OF AND REFERENCE TO THE WORK.

The syllabi are adapted to the student, and may be used by teachers of materia medica and pharmacy as affording classifications of the officinal preparations.

Working formulas are inserted for the use of the practical manipulator; they are so displayed as, with ordinary care, to avoid mistakes in compounding.

Comments upon the uses and properties of the officinal preparations follow the respective syllabi.

The processes for preparing and dispensing medicines are separately described and illustrated in the first chapter in Part III., in the several chapters of Part IV., and in Parts V. and VI.

Chemical compounds are displayed in the syllabi so as to show their composition, most prominent properties, and doses; their composition is further given with the process for their preparation, and its rationale, in the text.

In consulting the *index*, the most ready method of finding a preparation is to refer to the class to which it belongs—a salt is best found under the Latin name of its base.

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PRACTICAL PHARMACY.

PART I.

FURNITURE AND IMPLEMENTS.

CHAPTER I.

ARRANGEMENT OF DISPENSING STORE.

No directions can be given to suit all conditions and circumstances for the arrangement of the pharmaceutical store. The most common limit to completeness in this is want of capital. Pharmacy is a profession in which knowledge, skill, and integrity constitute the leading elements of success, and most of those entering it, and, from want of experience, consulting a work of this kind for advice, are limited to a few thousand dollars, which it is very important to economize. What is here offered has the merit of being disinterested and the result of much experience and observation, but completeness is not claimed for it. Druggists' sundrymen and wholesale drug houses issue illustrated and priced catalogues, in which are described many articles of use and ornament which would unnecessarily cumber these pages; they are freely accessible to all buyers.

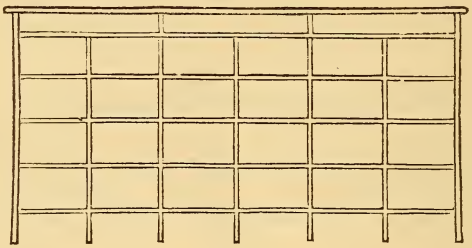
The chief objects of the arrangement of the store are the proper preservation of the goods in suitable quantities, and in positions readily accessible to those engaged in selling them, and the tasteful and attractive display of such as address themselves to the fancy of customers.

The goods ordinarily contained in a pharmaceutical or dispensing shop in the United States, consist, 1st, of crude drugs of vegetable and animal origin, in which are included many articles not used in medicine, but appropriately associated with medicines in the stock of a drug store, chiefly employed in dyeing, in the arts, and in domestic economy; 2d, chemicals, including some drugs, the chief uses of which are outside the range of medicine; 3d, pharmaceutic preparations in great variety; 4th, proprietary articles; 5th, toilet articles and perfumery; 6th, articles of diet for invalids and infants; 7th, apparatus for administering medicines, nursing bottles, etc. To these are added, in most stores, soda water on draught, and, in many, a variety of so-called fancy articles not easily classified.

How to dispose of these to the best advantage in the store is the point now under consideration. The most obvious method is to take pattern by a store already furnished, but much may be gained by considering the requirements of the case and seeking to improve on the old methods.

Stores furnished twenty years ago have numerous drawers, sometimes a hundred or more, chiefly for the storage of the first of the above classes; occasionally these were lined with tin, a useful precaution in those designed for the gum resins, oleo-resins, and the more perishable herbs and leaves. A modern improvement is to substitute for many of the drawers tin cans neatly and uniformly painted and labelled. Fig. 1 exhibits a case of drawers such as are

Fig. 1.



Case of drawers.

manufactured on a large scale, where lumber is cheap, with the aid of mortising machines, finished and faced with black walnut, at the establishment of John M. Maris & Co., Philadelphia.

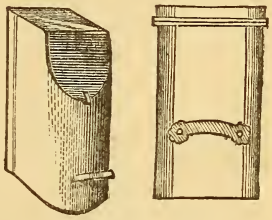
They are chiefly recommended by their cheapness, costing much less than similar drawers can be made for by a carpenter even under favorable circumstances. The material best suited to make these drawers of is well-seasoned poplar or clean white pine. It is to be remembered, however, that such drawers as are here described are not made well and smoothly enough to meet the requirements of a very particular pharmacist. The sizes found most convenient for the generality of retail stores are $5\frac{1}{2}$ inches deep, 9 inches wide, and 10 inches long. The back and bottom of the frame or case in which the drawers are placed should be covered with tin or galvanized iron to prevent rats and mice from injuring the drugs placed in the drawers. The drawer-pulls are sometimes made of iron with an open frame for inserting a glass label; but most of the patterns are objectionable from the careless manner in which the label has been fitted to the frame; the glass is also liable to be broken by rough usage. Paper labels are published in a variety of styles and patterns designed for drawers, cans, and bottles; they are very cheap, and serve a good purpose where cheapness is the leading motive.

A gilt label painted directly upon the drawer, although an old style, is perhaps the best. It is not always convenient to have this put on by an expert sign painter, and a good method is to obtain a plain glass sign and cement this upon the drawer-front in a way hereafter described for bottles. In this case, the drawer-pull may

be dispensed with by hollowing a suitable slit on the lower edge of the drawer to allow of the fingers being inserted.

Figs. 2 and 3 represent japanned tin cans, well suited to replace the drawers for such substances as flaxseed meal, mustard flour, and arrowroot, which would require a gallon size. Fig. 2, vanilla, saffron, lavender-flowers, rosemary, and the like, which, in a strictly retail store, might be placed in the quart size. When made of the pattern of Fig. 3, the lids should be large enough to slip easily on to the cans, which should be slightly tapering near the top, so that when the lid is evenly raised the weight of the can and its contents will cause it to drop on to the counter.

Fig. 2. Fig. 3.



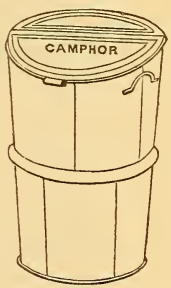
Cans (standing top and round).

Only those drugs which are bought in considerable quantities will require duplicate cans, or other vessels, in the store-room or cellar, and where a single receptacle is provided, it should be of the size to hold the whole amount purchased at one time. It is very objectionable to allow paper packages of a variety of drugs to accumulate in a large drawer or other receptacle; beside the danger of the duplicate package being overlooked or forgotten, when the proper drawer or can is to be replenished, the contact of one package with another is often injurious to both.

A few articles, such as carrageen, Iceland moss, and hops, unpressed, are so bulky as to require especially large receptacles in the store; for these a few cans of extra size should be appropriately located, so as not too much to break in upon the general plan.

Fig. 4 shows a large can for camphor, having a solid diaphragm across the diameter about half-way from the top to the floor on which it stands; a piece of glass is fitted into the lid by means of a small ledge soldered on to its under surface, on this there is a gilt label. To diminish its resemblance to similar cans in grocery stores it is japanned of a light-buff color, to match the cans on the shelves.

Fig. 4.



Camphor can.

It would extend this chapter too much to give a list of drawers, cans, and bottles, and their appropriate sizes. The experience obtained during apprenticeship, with an intelligent view of the population and general characteristics of the location selected, will give some idea of the shop furniture to be provided and the stock to be purchased. To some, the proper advice would be to buy very cautiously, leaving room for improvement as the business develops; others would require to be reminded of the importance of having every facility for business in advance, giving the idea of completeness the first place in the mind.

Chemicals are almost universally kept in glass bottles, excepting borax, potash, saltpetre, pearlash, Glauber salts, Epsom salts, mu-

riate of ammonia, carbonate of ammonia, and a few others sometimes sold in quantities of several pounds; drawers and tin cans are unsuited to some of these, and a few stoneware jars with suitable tight corks or caps should be located for their reception out of sight, but not too far from the dispensing counter.

Most of the chemicals should be kept in quart salt-mouth bottles on the shelves; these hold from one to three pounds of ordinary salts. Some of the more costly salts, such as iodide and bromide of potassium and chloral hydrate, are as well kept in pint salt-mouths; then there are a few, such as iron by hydrogen, the chlorides and iodides of mercury, the salts of bismuth, sulphates of quinia and cinchonia, which are appropriately kept in half-pint and four-ounce salt-mouths.

The practice of keeping the ordinary small crystals and crystalline powders in the original packages sent out by the manufacturers is not without advantages, but requires they should be kept in a chemical case, and this, when open to view, fails to impress with an idea of systematic arrangement and care. On the whole, it seems best to provide a regularly labelled shop-bottle for each of the chemicals, and to keep the original packages as duplicate bottles in a chemical case. Of the several kinds of salt-mouths, that shown in Fig. 5 is the most popular. Figs. 6 and 7 also represent approved kinds. The leading considerations which determine the quality of glassware are shape, surface, and weight.

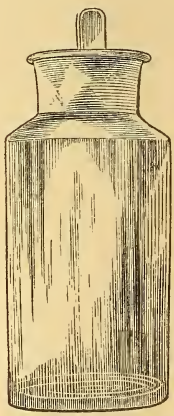
Fig. 5.

Salt-mouth mushroom stoppered.

Fig. 6.

American blown salt-mouth.

Fig. 7.

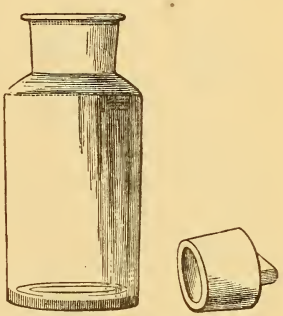


Moulded salt-mouth.

The shape of the bottle, whether square shoulder or round shoulder, and whether relatively tall or short, may be partially determined by the height of the shelves, but is rather a matter of taste than of utility; the weight of the bottle is, however, of importance as determining its strength. The New England Glass Company make their quart salt-mouth and tincture bottles of ordinary thick-

ness to weigh about 19 ounces, including the stopper; they also make them extra heavy to weigh 2 pounds; the corresponding pints weigh 13 ounces and 19 ounces respectively; the ordinary half gallons weigh two pounds; extra heavy, 2 pounds 12 ounces. Their finest bottles are all carefully levelled and punted on the bottom. They are blown and finished without a mould, but the stoppers are now universally made in a mould and are hollow, as shown in Fig. 8. The New England Company's price upon the extra heavy bottles is from 30 to 35 cents per pound, according to circumstances. There are, however, other makers furnishing much cheaper wares, serving an equally good purpose.

Fig. 8.



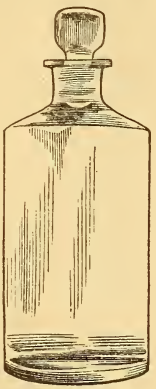
Salt-mouth and stopper.

Bottles made in a mould have a less elegant surface, but are more uniform in shape, than blown bottles. Figs. 7 and 8 represent such; they are mostly found of sizes below the quart. Since the invention of cylindrical moulds of solid iron so thick as to retain the heat of the successive charges of fused glass blown into them, the unpolished surface formerly produced by the sudden chilling of the glass on contact with the mould, has been greatly obviated, and a handsome bottle is the result.

Fig. 9.

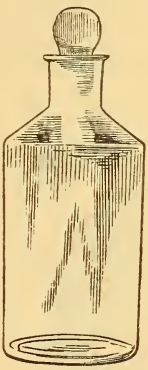
Tincture mushroom stopper.

Fig. 10.



Ordinary blown tincture.

Fig. 11.



American moulded tincture.

Most of the numerous liquid pharmaceutical preparations are kept in bottles such as are here figured, called Tincture Bottles. The present prevailing style is the mushroom stopper, Fig. 9; it is in this respect superior to that shown in Fig. 10, that it always is in a correct position to the face of the bottle. The moulded tincture is adapted to range on the same shelf as the corresponding

salt-mouth, Fig. 7, and it is often found convenient in the prescription case to adopt this kind, especially where an alphabetical arrangement is preferred.

Fig. 12 represents a bottle which is admirably contrived to keep fixed oils, for the purpose of dispensing. The lip of the bottle is furnished with a flange nearly at right angles to it, which is ground on the outer surface, so as to fit a cap shown separately in the right hand figure. Into the neck of the bottle is inserted a ground glass stopper, also shown separately in the drawing, which is perforated by a lipped tube, and has upon the side opposite the lip a groove for the admission of air in pouring out the oil.

Fig. 12.

Oil bottle.

The object of this arrangement will be obvious. In drawing oil from the bottle it flows through the tubed stopper, running in a thin stream from the lip, and any portion which runs down the outside collects in the gutter formed by the outer lip and runs back into the bottle through the groove in the side of the stopper. The cap keeps this oily portion from becoming dusty, and protects the contents from the action of the air. A bottle of this description may be used without becoming greasy on the outside.

Fig. 13 represents a tin vessel for dispensing fixed oils; the lip around the neck of the can collects the waste oil, which flows back through a small hole into the vessel. It is covered by a tin cap, shown in the drawing, and is a cheap and durable substitute for the oil bottle, especially adapted to larger sizes and for oils retailed in large quantities for manufacturing purposes.

Fig. 13.

Oil can with cap.

Fig. 14.

Syrup bottle, loose stopper.

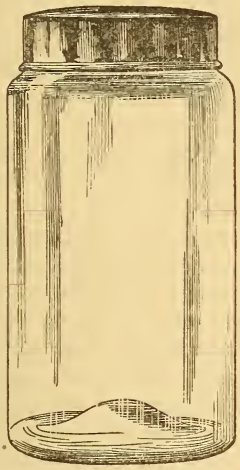
Ordinary cans of tinned iron are objectionable for brandy and other liquids containing tannin, which by contact with the iron exposed at the edges are blackened and rendered inelegant; block tin is too soft to be durable; it is only by preventing the edges of the tinned iron from contact with the contents, by special precautions, that this useful alloy can be rendered available for this class of liquids.

Fig. 14 shows a furniture bottle designed for keeping syrups. In place of the ordinary tightly-fitting ground stopper, a loose stopper of glass is supported in the neck by a bulb resting on the lip, which is so flared as to cause a syrup to flow

back into the bottle instead of flowing over on to the outside. Though not air-tight, these are sufficiently closed to keep out the dust, which is sufficient for ordinary dispensing purposes.

Besides the foregoing, there are two kinds of bottles frequently employed, where cheapness is the chief consideration, viz.:—

Fig. 15.



Specia jar.

Fig. 16.

Common wide-mouthed packer.

The *specia jar*, which consists of a wide-mouth bottle without a lip, the mouth of which is covered by a tin top. This is objection-

Fig. 17.

Extra wide-mouthed packer.

Fig. 18.

Common packing bottle.

Fig. 19.

Extra packing bottle.

able as not excluding the air, and it is also less neat and substantial than the salt-mouth. It is, however, less costly.

The packing bottle, which is made either with a wide mouth for solids, as in Figs. 16 and 17, or a narrow mouth for liquids, as in Figs. 18 and 19; these are stopped by corks, and are the least desirable kind of furniture bottles, though very useful for transporting medicines, or for keeping extra supplies with which to replenish the regular furniture bottles. Packing bottles are comparatively cheap, and are generally made of stronger glass than salt-mouths or tinctures. They may be formed without a lip, called common (Fig. 18), or with a lip, called extra (Fig. 19). Those with the lip are the most approved, and hold somewhat more than their nominal capacity.

The use of colored bottles has been recommended in furnishing the shelves of the shop and laboratory, as tending to prevent the destructive influence of light on some salts of mercury and silver, and on certain organic substances, volatile oils, and tinctures. Of the various colors which have been recommended, blue was formerly preferred, though recent authorities maintain that blue has no action on the chemical rays, and advocate the adoption of red glass as the best adapted to prevent the injurious effect of light. Some photographers successfully protect the apartments in which they conduct their delicate manipulations by yellow glass, which suggests the use of this color in the manufacture of furniture bottles requiring such precautions. The free access of light may be prevented by a coating of black varnish, or by the less elegant method of pasting over the surface some dark-colored paper.

Fig. 20.

Fruit jar.

Fig. 20 shows a form of air-tight bottle made for preserving fruits which is of strong green glass, and well adapted to keeping such substances as carbonate of ammonium and assafœtida, which are especially unsuited to ordinary salt-mouths. The mouth of the bottle is wide enough to introduce the hand into, and when the cap is brought into place the junction is so nearly air tight as to prevent the change of carbonate of ammonium into the soft and pulverulent bicarbonate.

In the case of bottles, displayed on the shelves, gilt labels are now very generally used. The New England Glass Company gild an appropriately-shaped space upon the bottle, and then put it into the fire so as to fuse a thin coating of glass over it, and the letters are afterwards put on with paint; but this is a very expensive process of gilding. A more common method is to apply the gold on the under surface of a curved glass label, on which the letters have been previously painted backward, then to cement this on the bottle with a dark-colored cement. The cement is composed of 3 parts of resin and 1 of wax.

Fig. 21.

Glass label.

One of the advantages of this method is that the labels can be prepared systematically by expert letterers, then sent to the required place and applied to the bottles at leisure. They can also be removed at any time by the application of sufficient heat to soften

the cement. The exposed surface of the glass is free from paint or gilding, and may be cleaned and polished without injury. On moulded bottles there is sometimes an indented label-space to hold a glass label of the kind described, so as to bring the surface of the label nearly into a line with the bottle, but to secure this is not practicable in making blown bottles.

Bottles for acids are very commonly made in moulds with the name of the acid blown in the glass, or it is not uncommon to engrave the name of the acid upon the surface of blown glass bottles, as in Fig. 22. The new process for etching on glass with a strong current of sand is quite applicable to this method; the use of fluoric acid does not produce a sufficiently sharp and conspicuous label.

Fig. 22.

Acid bottle.

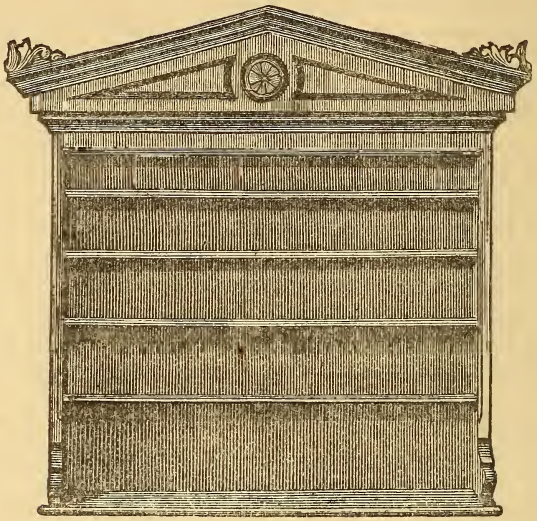
The use of printed paper labels is so much less expensive than either kind heretofore mentioned, that it still prevails in a large class of stores, especially in the rural districts and suburbs of the cities. To meet the demand for these, and to promote the use of correct nomenclature, the Philadelphia College of Pharmacy formerly published several sets of Latin shop-labels for drawers and bottles, each set containing an assortment embracing several different sizes, according as the articles are usually kept in large or small quantities. These had a large sale, and it is an interesting item in the history of this pioneer institution for pharmaceutical education, that during a period of great monetary embarrassment, the publication of Latin labels was one of its leading pecuniary resources. The enterprise of rival printers and lithographers has of late years put improved sets into the market, and the College has, for the present, ceased any further connection with the business, than to continue editing its own edition, published by Ketterlinus, of Philadelphia.

After having pasted the label on the bottle or drawer, by means of mucilage of tragacanth, or other convenient paste, and stretched it tightly over the part, it should be smoothed by laying a piece of thin paper upon it, and pressing it uniformly with the thumb. When it has become dry, it may be sized by painting over it a thin coating of clear mucilage of gum Arabic. This should extend a very little over the edges of the label. It should then be dried again, and varnished with spirit varnish; this not only improves the appearance of the label, but renders it durable and impervious to moisture.

It is customary in the arrangement of a store to place the drawers immediately above the washboard to the height of about 3 feet, and to surmount it by the shelving on which the bottles are placed. Where practicable the shelving should be limited in height so that the top row of bottles should not exceed 6 feet 9 inches. It can then be reached from the floor; the cornice or finish surmounting the whole may be light or heavy according to taste and the height of the ceiling. Fig. 23, which is drawn $\frac{1}{30}$ of the full size, shows the arrangement of a section corresponding with a section

of drawers shown in Fig. 1. The top and shelves are here supported by uprights of the same width as the shelves, and faced by an appropriate moulding · it will be seen by its length, which is

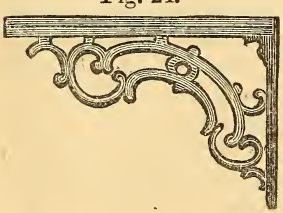
Fig. 23.



Section of shelves.

5 feet 8 inches, that it will allow of 12 half-gallon and 32 quart bottles; if a row of pints were added, it would contain 64 bottles, but it would not come within the prescribed height, and would require a movable stepladder or stool to be always at hand. Where the top shelf is just beyond reach from the floor, a permanent step is sometimes laid along the whole length, just high enough to escape the bottom drawer. Perhaps in a majority of instances it is rather impracticable to limit the height of the shelving as above indicated, on account of limited wall space, but another expedient would be to lower the height of the drawers by omitting one range, and thus obtain room for another shelf of bottles within the limit. A saving of wall space is also obtained by omitting the uprights and pilasters, and securing the shelves from behind. Fig. 24 shows an iron bracket used for this purpose; these are made of various sizes and patterns, and, being larger in one direction than another, may serve by reversing them for sustaining a narrow or comparatively wide shelf. The width of a range of shelves is generally uniform, and does not exceed 7 inches, and is sufficient for the largest bottles. The omission of the uprights requires that the shelves should be upon the same level along the

Fig. 24.



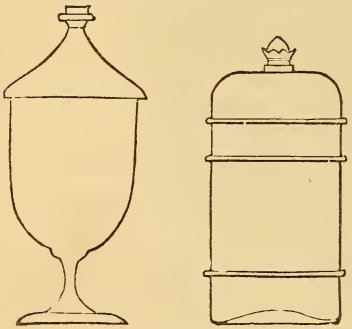
Shelf bracket.

whole line of the wall, and thus giving continuous ranges of bottles of the same size and style. Where the bottles are handsome and handsomely labelled, this looks very well. It also favors an alphabetical arrangement, beginning at A on each shelf and range of drawers, and running backward from the front of the store. The material of the shelving will be regulated partly by ideas of expense, and in many first-class stores in the United States oiled black walnut is being substituted for painted pine, and certainly has a more substantial and rich appearance. Formerly the bottom row of bottles was of two-gallon size, then succeeded gallons, half gallons, and quarts, and in separate sections 5 or 6 narrow shelves of pints and half-pints, reaching from the bottom to the same height. These serve to break the uniformity, and bring many important articles, which are kept in small quantities, within convenient reach; the rarer articles on the top shelves are reached by a ladder. This has recently been so far changed as to omit the larger bottles; a few half-gallon salt-mouths occupy the first shelf, and quart salt-mouths and tinctures the two shelves above; the pints and half-pints are either placed in separate sections or arranged in a prescription case with four- and two-ounce bottles, some of which are duplicates of the larger bottles, and others calculated to contain the whole amount of stock of their respective contents.

Cases.—Part of the wall space in a dispensing store is usually devoted to cases for proprietary articles, perfumery, and preparations put up and labelled ready for sale. Sometimes these are on the top of the cases of drawers, under the bottles, but more frequently they break the uniformity of the continuous lines of bottles, sometimes affording a convenient division between salt-mouths and tinctures; or they may occupy the whole of one side or end of the store to the exclusion of the furniture bottles. In the storage of this class of goods, one object is to keep them in full view of customers; to this end show cases are also disposed upon the counters and even in the windows, and it is found by experience that goods so displayed, to use the commerical phrase, sell themselves. The professional idea of a pharmacy or dispensing store is rather adverse to the extensive sale of goods not directly demanded by the exigencies of sickness, but it must be admitted, that the public expectation and demand is that the pharmacist should supply a great variety of articles touching only indirectly upon his ostensible pursuit, and it is undoubtedly true that a large number of pharmacists throughout the United States, owe the ability to conduct their business profitably to the demand upon them for proprietary articles, and articles of utility and ornament connected with the toilet. The vicinity of these to the counter and till will diminish the disturbance of dispensing operations in times of unusual pressure of business, but it should not be forgotten, as in keeping with the general objects of the store, to bring into equal prominence such familiar and attractive drugs as will be recognized and appreciated by intelligent customers.

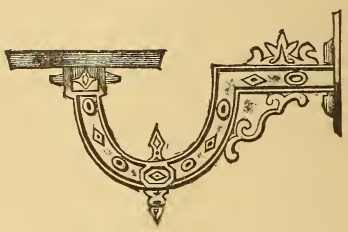
Cut glass jars of choice gum Arabic, tragacanth, liquorice, ichthyocalla, vanilla, rhubarb, and French rose may well occupy conspicuous positions in the store. Figs. 25 and 26 represent forms of show jars which are adapted to this object. For supporting these and other ornamental bottles and jars in the windows and

Figs. 25 and 26.



Show jars.

Fig. 27.



Window bracket.

other parts of the store, brackets such as are here shown, Fig. 27, are useful. The globes of colored liquids, which have been from time immemorial insignia of the craft, are generally mounted on such brackets. Care should be taken to have these liquids to contain sufficient alcohol or glycerin to prevent their freezing and bursting the globes, and discharging their contents perhaps over valuable goods.

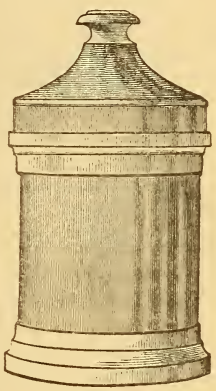
The drawers, salt mouth and tincture bottles, upright and flat cases, and fancy jars for the counters and windows will accommodate such of the ordinary drugs as are sightly and desirable to be kept in proximity to the dispensing counter. Such apparatus as bedpans, urinals, syringes, nursing bottles, and nipple shields, should have deep drawers or closed cases allotted to them, where they can be kept in considerable variety, without deterioration or undue exposure in the general course of business. The stoneware jars already referred to, as adapted to heavy chemicals, may stand on shelves slightly elevated above the floor, under the back counter, in the cellar way, or in some appropriate closet readily accessible—rotten-stone, pumice-stone, and camphor are also suited to such a position. Sponges are so bulky as to require special provisions for their accommodation. Ornamental baskets or large jars for the front windows and counters are mostly used; or the fine qualities are hung up upon the strings on which they came, and the coarser put away in a large drawer in the counter, or perhaps in a barrel in the cellar; this article of commerce is among the least profitable in the store, but cannot be left out on that account.

The fixed oils and fats should have a separate closet in the counter or elsewhere, appropriated to them; if on the shelves even in oil bottles, Fig. 12, the oils will seldom be kept from soiling the

bottles and shelf. Some of them, as castor oil and sweet oil, require to be kept in considerable quantity. Experience is against keeping cod-liver oil in any other way than in sealed bottles not exceeding one pint in capacity. The large oil cans may be kept in the cellar or vault, and used to replenish small ones or bottles in the ointment closet. A shallow tin tray of the size of the shelf is an advantageous arrangement; a few strips of tin edged up serve to prevent the soiling of the bottom of the bottle.

Extracts require a separate closet, which may appropriately be in the counter, and should contain shelves for at least thirty jars of this very important class of preparations. Ointments and extracts are usually kept in jars made of porcelain or queensware. These vary in quality, in color, and in shape. They should not be made of very porous material, especially if designed for ointments, and should be well glazed, both on the inside and outside surfaces. The best are manufactured in Staffordshire, England, and at the royal manufactories of Prussia.

Fig. 28.



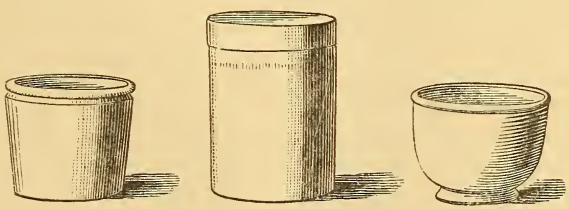
Canopy-top jar.

In regard to the shape of *jars:* the variety called canopy-top (Fig. 28) is generally preferred, as having a more finished appearance than the flat-top (Fig. 30).

Jars should never be labelled on the top, as the tops, being of about the same size, are liable to be misplaced, and mistakes occasionally occur in this way.

Ointments and extracts are also frequently put into queensware jars without tops, called *gallipots* and *tie-overs* (Figs. 29 and 31). These are cheaper than covered jars, but are inconvenient and ill adapted to the preservation of the substances kept in them. They are usually tied over with kid, bladder, or parchment. Extracts rapidly lose their moisture when kept in tie-overs or gallipots, and soon become deteriorated. Ointments also undergo a change under

Fig. 29. Fig. 30. Fig. 31.



Tie-over jar. Flat-top covered jar. Gallipot.

these circumstances, frequently becoming rancid. When tie-over jars or gallipots are used, it is well to cover the top with a piece of tin-foil or waxed paper previous to securing the skin over them, but as soon as this has been opened the contents are exposed to the

Fig. 32.

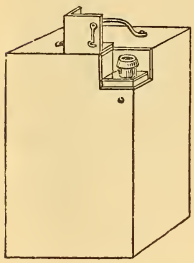
Covered jar with tin box.

influence of the air and to the accumulation of dust, and practically they are seldom tied over again.

A device I have adopted for preserving extracts in the tie-over jars in which they are received from the manufacturers, is to inclose the jar in a tin box, just large enough to receive it, and having a well-fitting top which serves to keep out the dust and to prevent evaporation. Fig. 32 shows this; A represents the body of the box, B the jar, and C the tin top or cap; when weighing out a portion of the extract, the jar is removed from its box, and restored to it when finished.

Volatile oils should be kept in stock in small quantities, except the few which are in large demand. Oil bottles, Fig. 12, of small size, are best suited for their preservation; these may be made of colored glass, or, preferably, kept in a dark closet. When common vials are used, cans of appropriate size to hold the vials afford a good protection. Some careful pharmacists empty the original packages in which the oils are received into small vials, carefully cleaned and dried; these are filled to the neck, corked securely, and set away in a closet, to be opened only as required.

Fig. 33.



Patent safety can.

The patent safety can here figured is very generally used for the transportation and storage of oil of turpentine, benzine, and similar inflammable liquids; it consists of a can of tinned iron inclosed in a wooden box, with a tubule for filling it, and one for drawing the liquid from it. Such cans may appropriately replace glass vessels for the storage of the above-named class of substances.

Counters.—In the proper construction of a pharmacist's counter there is much room for ingenuity; the space which a counter may occupy, the uses to which it is to be put, and the necessity of storing goods in it, or otherwise, and if so, what kind of goods, should all be carefully considered in planning it. In any but a small store there will generally be at least two counters, frequently there are three or even four. Nearest the entrance to the store we have in the United States what is seldom or never found in European pharmacies, the soda-water counter and draught apparatus. This consists of a panelled front and ends, thirty inches high, on which is a marble slab perforated for the passage of pipes into the draught apparatus. The most approved kinds of these are more or less elaborate marble cases containing metallic coolers, syrup cans, and ice; the soda-water coolers are connected with a draught pipe for each of the kinds of carbonic acid water, plain, Vichy, and Kissingen being the usual varieties, and the syrup cans, with ornamental faucets for drawing the syrups. This counter usually contains some shelves for glasses and extra syrups, and a large sink, with hydrant

and wash pipe for washing glasses. The soda-water is either bought in the fountains which are delivered as often as necessary into the cellar, and attached by a coupling to the pipes connected with the draught apparatus, or made with an appropriate gas generator and force pump directly under the soda-water counter, in the cellar. The construction of this counter is so simple, and its use is so little within the range of pharmacy proper, that it need occupy no more space in this chapter.

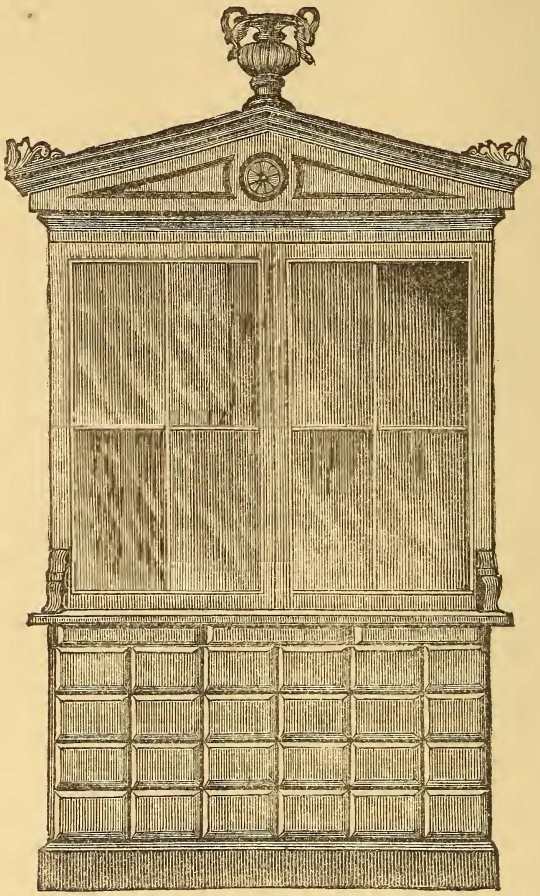
Passing the "soda fountain," as it is often called, we reach the main counter, on which articles are weighed, labelled, and wrapped, and over which they are sold. This counter may or may not be used also for compounding prescriptions and for other pharmaceutical processes, according to its length and the general arrangement of the store.

A different method of arranging and furnishing the store of a pharmacist has long been advocated; of late the method has so far been acted upon as to enable any one desirous of rendering his store both unique and conformable to this method to carry out this plan much more economically than it has heretofore been possible. The plan is to have the drawers and shelves made, as already described, in sections, each separate from the other, and placed at such distances apart as the space at his disposal will permit. The spaces on the wall between the cases of shelves can be appropriately used by securing ornamental brackets, whereon to support jars of tooth-powder, toilet articles, and such goods as are suitable for display.

In front of the shelving sash doors should be hung on *slip* hinges (for facility of removing them for the purpose of cleaning), glazed with glass of canary color or entirely opaque. Upon the inner surface of the glass ornamental lettering may be placed to relieve their blank appearance, and on the top of each glass the name of the class of preparations contained in the case might be conspicuously painted to serve as a directory to the assistants, and tend to impress the customer with the feeling that system was a ruling characteristic of the establishment. The location of the different cases is a matter of importance; the front of the store near the windows should be appropriated to the soda-water counter, and as there will be many who will call specially for soda-water, those classes of objects which have the least immediate connection with the more strictly pharmaceutical portion of the business should be grouped in that part of the store; these will include the perfumery and toilet articles generally found in such stores, and next to this should be placed the cases devoted to proprietary articles, and those substances which are usually kept in parcels ready for sale; next to this should be placed the cases of shop furniture bottles, which contain those remedies in most constant demand for the ordinary calls of promiscuous trade, and then those which belong more to the dispensing of prescriptions and recipes for domestic practice. The accompanying figure illustrates the character and style of cases here recommended.

Of course this is but a general outline of the plan which must be filled out in accordance with the judgment of the pharmacist to

Fig. 34.



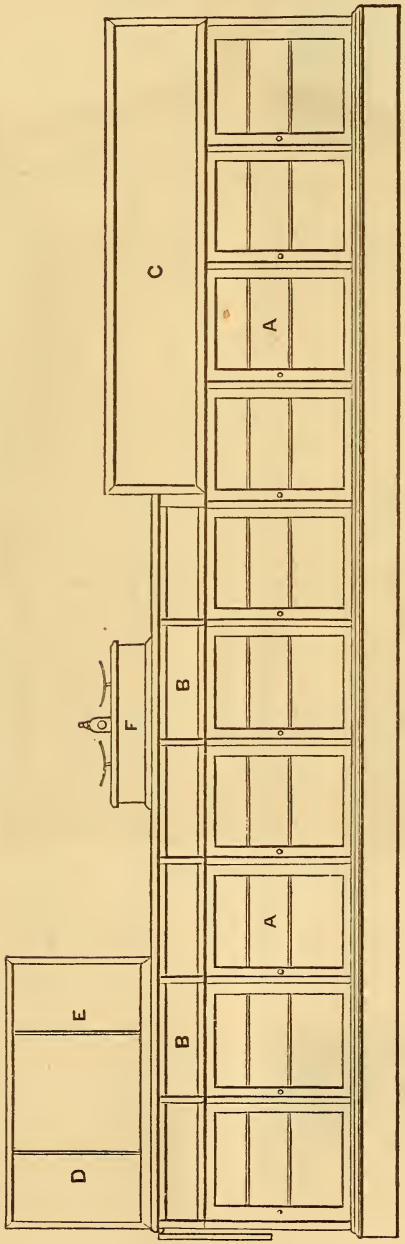
Section of drawers and covered shelves.

suit each particular case. The advantages belonging to this method are facility of arrangement, classification of stock, and preservation of the contents of the bottles from the injurious effects of light, facility of removal in case of fire or change of business location, and economy in outfit when fixtures of equally good appearance are obtained in the ordinary method of building them especially for the room they are to occupy.

Fig. 35 shows the front of a dispensing counter. The casing along the front was adopted with a view to storing and displaying goods, the want of ample case room in the store having made additional accommodations of this kind desirable. It is liable to the criticism of the goods being too much below the line of vision to draw much

attention to them, but this is diminished when customers are sitting on the chairs opposite. It is remarkable that, although this counter has been in use for many years, not a single light of glass has been broken on this front. The lights are French plate, but not of double thickness.

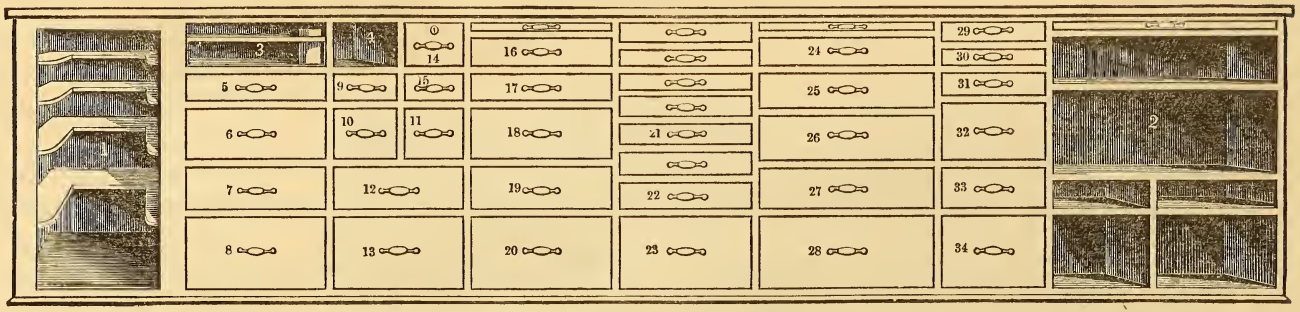
Fig. 35.



Dispensing Counter—Front View.

A A. Show-cases with glass doors.
B B. Drawers with glass fronts.
C. Counter show-case.
D. Desk.
E. Prescription scales.
F. Counter scales.

Fig. 36.



DISPENSING COUNTER—BACK VIEW.

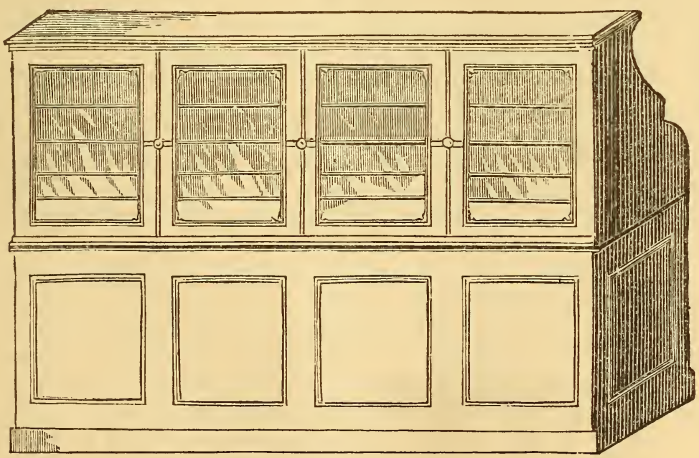
1. Closet 20 in. wide by 14 deep, containing extracts and ointments in 4 oz. and lbss jars; the arrangement of the shelves on each side across the back of the case allows of 60 jars; this is protected by a door, not shown in the drawing.
2. Open shelves for mortars and pestles, ointment slabs, adhesive plaster, plaster irons, etc.
3. Slide consisting of two shelves, into which the paste-pot is secured.
4. Open space for towels.
5, 6, 7, 8. Drawers for prescription vials from fʒij to fʒxij, separated by partitions across the drawers up to the shoulders of the vials.
9, 10, 11. Cork drawers, with partitions so as to contain a variety of sizes.
12, 13. Syringes and gum-elastic wares.
14. The till, conveniently arranged to hold the sales-book, the petty cash-book, etc.
15. The drawer for postage and revenue stamps. (To this point the two top drawers are made short, to permit the show-case to be set in to the depth of 7 inches on the front of the counter.)
16. Cut paper for packages.
17. Capping and fancy papers.
18, 19. Sheepskins, chamois, etc.
20. Sand-paper and syringes.
The series containing 21, 22, and 23 are drawers for cut and uncut labels.
24, 25, 26, 27. Pill, powder, and ointment boxes and jars, assorted.
28. Large uncut paper.
29, 30. Two pill machines.
31. Pill tiles.
32. Tool drawer.
33, 34. Uncut castile soap.
Over 2, 24, and 16, are slides of oak and cherry, for folding powders and large packages, and for containing the ointment slab and tiles in use.

Fig. 36 exhibits the back view of the same counter, fourteen feet long, thirty-two and a half inches wide, and three feet high. The top is covered in part with marble, and back of the cases with oil-cloth; a large glass show-case occupies the left-hand end, but not the whole width, the bottom being seven inches below the top level of the counter. The whole structure is movable, being in three parts, so accurately fitted together as not to show a seam or crack at the junction. It contains no sink, the washing of bottles, implements, etc. being accomplished in a large sink in the operating counter back. The prescription scales are in a case near the right hand end of the counter over the oak slide for folding powders, and near the drawers for boxes, pill tiles, etc.; and the larger scales are near the middle, over the paper and label drawers.

A small mahogany desk with writing materials, and containing in a drawer blank labels, slips, blanks for prescriptions, etc., is placed on the counter immediately adjoining the prescription scales, thus avoiding the carrying of every prescription and label to the large desk used for the accounts and the general writing purposes of the establishment.

The prescription counter may appropriately be a distinct feature in the store, located further from the entrance, sometimes in a line with the dispensing counter, but more generally at right angles to it. Fig. 38 shows the back view of one recently constructed, and although with a minimum of appointments, found ample for a very considerable prescription business. It is drawn with a case of shelving upon it, which, in front, is a show-case. Fig. 37 shows the front view of this counter.

Fig. 37.



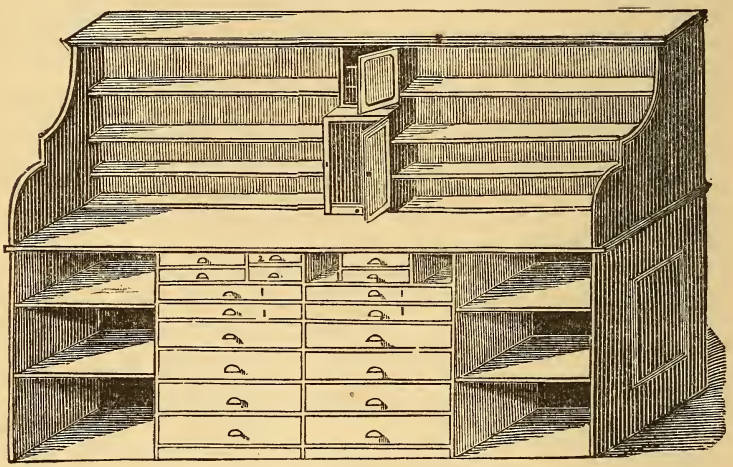
Front of prescription counter.

The dispensing counters have the front and ends of oiled walnut in panels, the drawers and shelving of the back of pine or poplar stained. All have white marble tops. The drawers are arranged,

some with suitable compartments for labels, and others for pill machine, corks, paper, bottles, etc.; while the open spaces afford the necessary room for cork-presser, mortars, pill tiles, spatulas, paste-pot, etc. These counters are well made, and the whole appears as a handsome piece of furniture.

Fig. 37 shows the front, and Fig. 38 the back, of the largest size, 7 feet long, 2 feet 3 inches wide at the floor; top shelf 11 inches wide, and height over all 5 feet 6 inches. The front of the

Fig. 38.

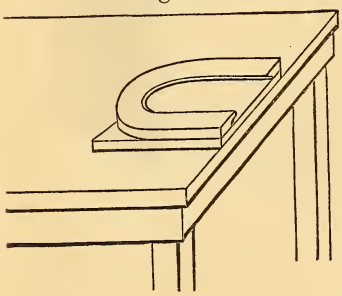


Back of prescription counter.

counter (Fig. 37) has four glass doors, with shelves 3 inches wide, forming a good show-case for the display of perfumery and fancy goods. The back has a scale case with glass door. On either side are shelves for the dispensing bottles—giving room for 10 pint, 20 half-pint, 28 four-ounce, and 34 two-ounce. The relative distances of the shelves from each other can easily be varied.

On the top of the prescription counter a frame should be screwed, about three-eighths of an inch thick, of hard wood, bevelled from below upwards, 3 or 4 inches in diameter. Two may be provided, of different diameters—in which to set the mortar for trituration while in use. It is especially useful in making a pill mass, furnishing in either corner a firm rest for the mortar against the force exerted in trituration; this is shown in Fig. 39. Several devices may be mentioned in this connection, which may especially suit the circumstances of particular stores.

Fig. 39.



Clamp for mortar.

Near the dispensing counter should be placed the sink, with the requisite

supply of water, both hot and cold, if possible, and the shelves on which the mortars and pestles should be placed. These shelves should incline towards the sink, so that any water may run off from them into the sink. The shelf for pestles is best arranged by having holes bored large enough for the handles to pass through, but not the heads, so they will remain in their respective places.

The best method of keeping those remedies which are of great activity, and consequently poisonous in overdoses, has engaged the attention of the most careful pharmacists, and much has been written both about their custody and dispensing. Some have adopted the plan of keeping them in a locked closet, which is perhaps the simplest and best method; others add to this an arrangement by which the opening of it strikes a bell, and also attach to the door a spring or weight which prevents the door being shut until the vial is intentionally replaced, acting as a reminder of the class of remedies being used.

In regard to the morphia salt, so often written for when the quinine salt is intended, a plan that has been pursued for years by some is to put only a few grains in the dispensing bottle at a time, so as to render it impossible that the number of grains of quinine ordinarily directed shall be dispensed without recourse to the duplicate bottle of morphia salt.

The choice of the place where the poisons are kept is of considerable importance. It is best to have it so situated that the proprietor, or, in his absence, the person in charge, will have it in full view from the place he generally occupies; it should be quite convenient to the prescription balance, as these articles are generally used in small quantities, and always should be weighed with great exactness. A specific place should be arranged for each bottle, and it, with its appropriate place, should be numbered in duplicate, so that misplacing bottles would not be likely to occur. A list with the numbers of the bottles and their contents should also be fastened in some part of the case for convenient reference; on this the maximum dose of each might well be written out in full.

In the Prussian pharmacopœias certain lists are published which prescribe the maximum doses to be dispensed, and in case of error the pharmacist is directed to ask the prescriber's attention before compounding such prescriptions.—*American Journal of Pharmacy*, 1871, vol. xliii. 391.

Where the top of the prescription counter is hardly large enough for all purposes, it may be extended by a lid upon hinges, which shuts away when out of use (shown in Fig. 36, at the right-hand end), and when powders are to be folded, may be raised or let down according to its position, and is then clean and ready. In the store of my friend James T. Shinn, of Philadelphia, there is such an arrangement, which renders available a space along-side of the prescription counter and over the steps leading into the cellar. If a slide immediately under the top of the counter is appropriated to folding powders, as in Fig. 36, it is apt to be drawn out and used incautiously for other purposes, and so becomes bruised and soiled;

while this is of light material and at an elevation above the level of the counter-top. In the same store there is a simple and satisfactory method of keeping cerates and ointments, in a convenient and accessible position, and at nearly the same temperature throughout the year. On the line of the steps leading into the cellar, a drawer is inserted horizontally, just below the floor, in which the ointments are arranged in flat-top jars. To reach them one has to descend about half way down the steps and pull out the drawer, when the required jar is readily removed. This, though a very cheap device and very economical of space, is less convenient to use than a dumb-waiter or elevator set into a closet, on which the ointments and very fermentable syrups are let down into the cellar and drawn up when required.

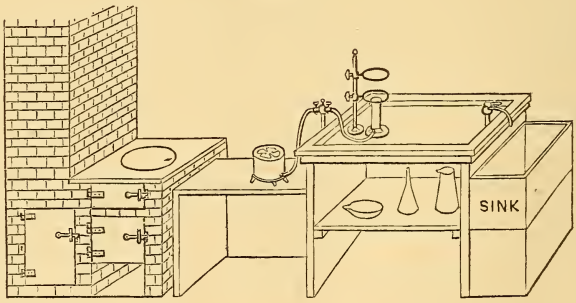
The working counter may be located in the back part of the store, or where the establishment is large enough to employ separate hands in the manufacturing department, it may be in a separate laboratory or in the cellar.

It is to be used for percolations, filtrations, evaporations, and small distillations, besides the making of syrups, spreading of plasters, and moulding of suppositories and other minor operations, when they are on too large a scale for the prescription counter.

It should be immediately contiguous to the gas and water supply, and to the sink; the top should be made of hard wood or oiled slate or soapstone, and have an inclination towards the sink. The top should project sufficiently to prevent liquids spilled on it from running into any drawer or receptacle beneath; and to more effectually secure this object, a groove, three-eighths of an inch wide and one-fourth of an inch deep, should be made around the entire top half an inch from the edge.

The best use to make of the room under the top of this counter is to fix shelves at such distances apart as will accommodate the

Fig. 40.



Working counter and furnace.

different utensils required to be used in the processes conducted at this part of the store; the dimensions of the counter will be limited to the space to be occupied; when it is ample, and some of the operations, as making of syrups and fluid extracts, require heavy

apparatus, the counter should be 3 feet 6 inches wide, and one part of it not more than 2 feet high.

Fig. 40 shows a working counter drawn to a scale of a quarter of an inch to a foot. It will be seen that the space under the top is left open to accommodate the apparatus, measures, funnels, etc., required as above suggested.

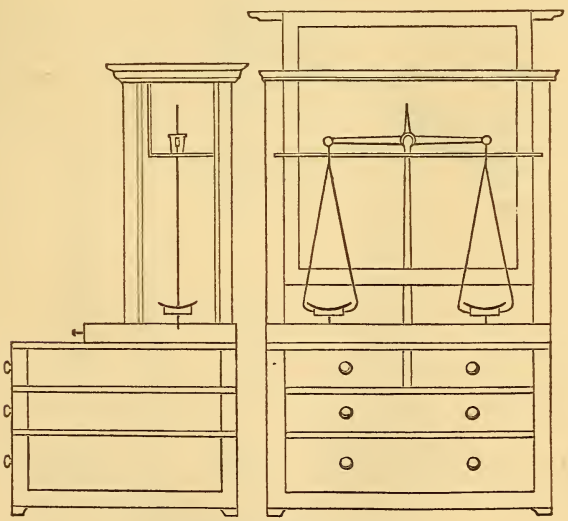
This counter should, if possible, be placed near a flue, in front of which a furnace is constructed with a closet at one side in the brick-work and communicating with the flue, so that all offensive vapors and gases may be carried off without annoyance to those in the apartment.

Having noted the general features which should characterize the dispensing apartment of a pharmacist's establishment, it seems appropriate that we should now describe those implements which are in constant use in the daily routine of business.

SCALES.—The scales should be two in number: The Prescription scales, suitable for weighing one drachm and under, and the Dispensing scales, for weighing two drachms and upwards.

There are different varieties of prescription scales; the most approved is that with an upright pillar, into the top of which is set a fulcrum, containing planes of hard steel, on which rest knife edges of the same material, placed just above the centre of gravity of the beam. Such scales are usually made of brass; the beam and scale-dishes are, however, sometimes made of silver. They vary in price

Fig. 41.



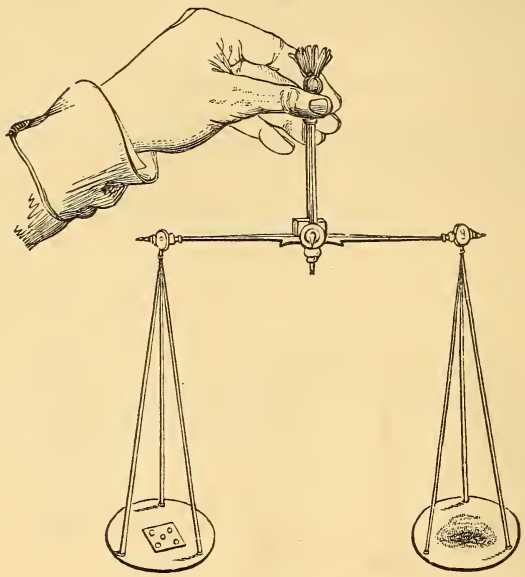
Prescription scales and case.

according to their material and workmanship, from ten to thirty dollars. To prevent injury from dust and the corrosive vapors which are frequently emitted from various substances in the store, an appro-

priate case is necessary; but the chief sources of injury to which a delicate balance is liable are the jarring motion of the building, which, by its constant action on the knife-edges, tends to dull them; the dust and vapors of the apartment; and, most of all, the rough usage they receive from those who attempt to clean them. Most of these causes can be removed by a proper arrangement of the balance and its case.

Fig. 41 (front and side view) represents the frame of the case, with a door which slides upward in a groove in front; a brass plate is supported in grooves cut in each side of the case, reaching from the back of the case to three-eighths of an inch of the front; a glass plate is fastened in perpendicular grooves, and extends from the under side of the top of the case to the lower edge of the brass plate which rests close against it; these make a separation of the upper part of the case from the lower; in the centre of the brass plate a hole is drilled sufficiently large to permit the lifting-rod, which raises the beam and its fulcrum, to move steadily but freely; directly under the knife-edges at each end of the beam a hole is drilled large enough to permit the free passage of the rods attached to the stirrups and hooks which rest on the knife-edges. It will be readily seen that dust or flies will be effectually prevented from coming in contact with the beam, and the only parts requiring frequent cleaning will be the stirrups and dishes which hang in the

Fig. 42.



Prescription scale without standard.

lower part of the case. A number of small drawers are provided, suitable for keeping the weights, papers for prescription powders, small spatulas, and other utensils required about the balance.

It is well to try the accuracy of the scales occasionally, as well by weighing exceedingly small quantities upon them when balanced by heavy weights, as by using two weights known to be equal and changing them to the opposite sides of the beam; this will show, at once, if there be the least deflection in either arm of the beam.

Owing to the comparative expensiveness of these scales, another kind is more generally purchased by physicians, in which the upright pillar is omitted. These are imported from England, France, or Germany; they come in boxes of wood or tin, and have the advantage of being much more portable. The best are made in England, and have steel beams. The German variety is usually imported from Nuremberg, and this is very inferior, and, indeed, frequently worthless. The physician who administers strychnia, veratria, or morphia may as well judge of the quantity by the eye as by the use of a pair of common German scales, which frequently fail to indicate it within half a grain or even a grain.

Fig. 42 exhibits the best form of prescription scale without upright pillar, as held when in use. The knife edges at the ends of the beam are of steel, inclosed; the movement at the fulcrum is free; and the scales are sufficiently accurate for ordinary purposes.

A cheap form has the ends of the beam open, and the cords attached to the plates secured to a little hook, which is slipped on to the curved ends, and readily movable; this arrangement is shown in Fig. 43. It is not generally so accurate as one with closed ends to the beam.

Fig. 43.

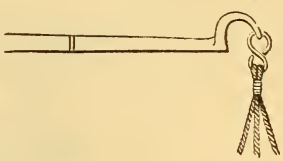
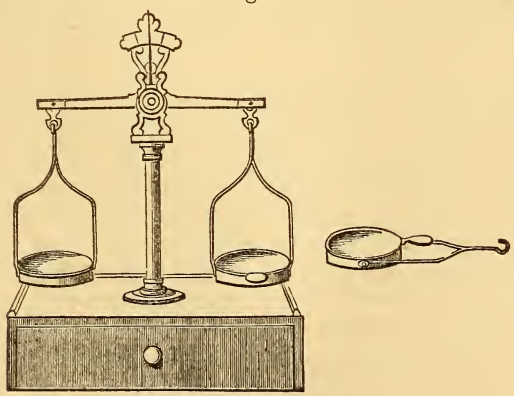


Fig. 44 shows the new scales introduced for use in the army by Troemner, of Philadelphia. The upright, which is of brass, stands upon a box to which it is secured by a screw; the beam is of steel, seven inches long, and moves in a central fulcrum

Fig. 44.



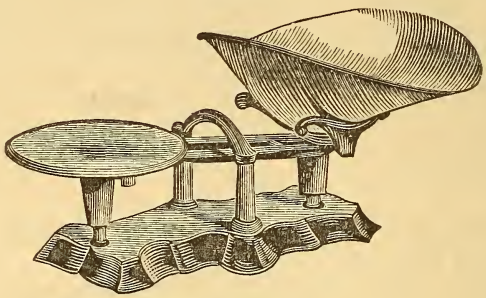
Troemner's army scales.

containing the knife edges. As it is necessary that the apparatus should be put away in travelling from place to place, the box is furnished with a drawer into which it fits compactly. The upright being unscrewed, the fulcrum lifted out, the beam unshipped, and the plates with their hanging attachments detached, the whole can be stowed away, with the weights, in the drawer. As the diameter of the plates would interfere with this, they are fitted with a hinge, which enables them to be bent in a line with their wire supports, as shown in the figure; in this position they occupy but little space.

Both in convenience of arrangement and in economy, this scale is a great improvement on those heretofore supplied to physicians, and will, no doubt, be sold, when the Government demand abates, at a price placing it within the reach of all.

Fig. 45 represents a kinds of scale for weighing ounces, which are selected on account of cheapness. These are manufactured of iron, varnished to protect them from rust, with a movable tin pan or scoop, and a platform arrangement of the beam. The instances

Fig. 45.



Cheap tea scales.

are rare in which the country practitioner purchases any scales except a small pair for prescription purposes, and these have been introduced rather as an improvement on the frequent practice of guessing at quantity than as representing the best arrangement for accuracy.

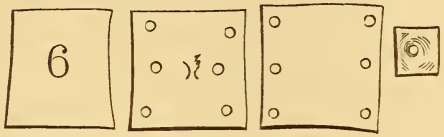
Large upright scales on the plan of those shown in Fig. 41 are perhaps most suitable to the purposes of the physician and pharmacist, though they are now less in use than formerly.

The best kind of platform balance for the dispensing counter is Beranger's pendulum scale, which is imported from France. The bearings, which are complex, are protected from dust and corrosion, and insure great freedom of motion and consequent accuracy, combined with sufficient strength for considerable weights.

The best location for the scales is on a level counter by itself, away from the jarring occasioned by the ordinary manipulations of the shop. It should be adjacent to the paper drawers, and should have room on it for both sets of weights.

Weights, although sometimes made in this country, are usually imported, of the smaller kinds, with the box scales. Those for ten grains and upwards are made of brass cut into squares, and marked with the officinal signs for denoting the different denominations of weight. Those for six grains and under are of sheet brass cut into squares, and variously marked with the number of grains, as shown in Figs. 46, 47, and 48.

Fig. 46. Fig. 47. Fig. 48.

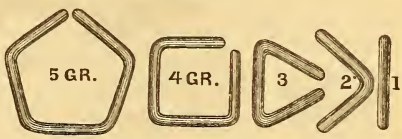


Weights of sheet brass.

The inexperienced are liable to error in using these small weights, from the fact that they frequently have, besides the marks denoting the number of grains, a stamp placed on them by the manufacturer, which is the German sign corresponding with our *gr.* (*grana*). (See Fig. 47.) This is liable to be counted with the other indentations, and to add one to the actual number of grains; a two-grain weight is liable to be taken for a three-grain, a three-grain to be used instead of a four, and so on. Close observation, however, will exhibit a decided difference between the two kinds of indentations.

The mode of marking shown in Fig. 46 is more liable to error than the others, especially when the weights become soiled and a little corroded by use.

Fig. 49.



Aluminium grain weights.

The best form of weights of the smaller denominations for the use of the pharmacist is represented in Fig. 49. They are made of aluminium wire; the shape indicates the relative number of grains in each weight; the half-grain, being made of much thinner wire, is not liable to be mistaken for the one-grain.

Within a few years past a description of weights from ℥ij to ℈ss has become common in our market, quite preferable to the German square weights of the same denominations. These are round, or eight-sided, stamped out of brass plates, with very distinct inscriptions, as shown in Figs. 50 and 51. They are imported from England, being the manufacture of W. and T. Avery, of Birmingham.

Fig. 50. Fig. 51.

Avery's weights.

Some trials made with common German weights convince me that few of those commonly met with are even reasonably accurate; a ℥j weight was found to weigh as high as

69.8 grains, and a gr. vj weight weighed 6.75 grains: others approximated more nearly; a ʒss weighed 30.25 grains, a ʒj 60.1 grains, a ℈ss 10.1 grains, a ʒij 120.5 grains, etc., while none of Avery's that were tried varied more than $\frac{1}{10}$ grain from their nominal weight. This inaccuracy may be partially due to carelessness and partially to the fact that the apothecaries' weights of the different German States, though bearing the same names and divided like our own, have different values, as shown in the sequel.

The larger apothecaries' weights, now superseded by the British Pharmacopœia, but continued in use by that of the United States, are almost invariably in the shape of cups, fitting into each other; the two inmost ones generally represent each two drachms, the next a half-ounce, the next an ounce, and so on up to sixteen ounces, in the larger nests. Now, as each cup represents a certain weight by itself, and as each is double that outside of it, excepting the two smallest, which are equal, the sum of any nest will be equal to that of any weight into which it fits; thus, the ℥xvj weight will balance the nest within it, which consists of an eight-ounce, a four-ounce, a two-ounce, a one-ounce, a half-ounce, and two-quarter ounces, and the entire nest will weigh thirty-two ounces.

This arrangement of weights, though very compact and convenient, and furnishing a prominent distinction between the apothecaries' and ordinary commercial weights, is more expensive than might be desired, considering the utility to the apothecary and physician of having a good supply of such important implements of his art.

The physician about commencing practice in the country, and desirous of economizing in this department of his outfit, may procure sets of these weights ascending as high as four ounces (Fig. 52), the nest weighing eight ounces. They will be found to answer his purpose in preparing tinctures, syrups, etc., in small quantities; and in dispensing the vegetable medicines for infusions; and in his weighing operations generally, less disadvantage would flow from the exclusive use of apothecaries' than of avoirdupois weights. The subject of weights and measures is more fully presented in the next chapter, where drawings will also be found of the other kinds of weights in use.

Fig. 52.

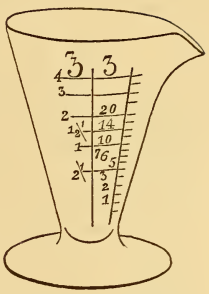
Nest of apothecaries' weights.

Measures.—As liquid substances are generally dispensed by measure rather than by weight, and as the Pharmacopœia directs the use of the officinal standard of measurement in preparations containing liquids, with but few exceptions, one or more graduated measures are necessarily embraced in the physician's outfit. A convenient one for dispensing operations is either a four or eight ounce conical measure, such as is shown in Fig. 53. These are of flint or of green glass, and are graduated down to one fluidrachm or half a drachm, which are the lowest denominations we generally wish to measure, and they can be filled several times in suc-

cession when it is desirable to measure a pint or a quart.

In selecting a measure, the chief points to be observed are, to have a good lip for pouring the liquids from, and clear and distinct marks both on the fluidrachm and fluidounce columns; the glass should not be very thick, as, by refracting the light, it interferes with accuracy in the measurement of small quantities. Large measures, which are not to be used for quantities under an ounce, may be appropriately made of the form shown in Fig. 54. One-ounce graduates of this description are sometimes made for medicine chests or saddle-bags where great economy of space is necessary, but they are too inaccurate for satisfactory use.

Fig. 53.



Graduated measure.

Fig. 54.

Medicine chest measure.

Fig. 55 represents a form of graduated measure in use among German pharmacists, which has the advantage of great exactness in consequence of its narrow diameter, thus rendering the vessel very desirable for measuring active medicines.

Fig. 55.

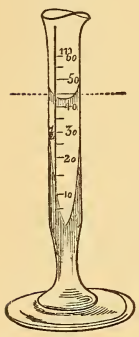
German graduated measure.

The measures ordinarily offered for sale are so frequently inaccurately graduated that they should all be tested before being employed. This is best done by having a series of flasks of the sizes capable of containing, in the bulb and portion of the neck, which must be of small calibre, respectively one-half fluidounce, one fluidounce, four fluidounces, and eight fluidounces; these flasks, when carefully counterpoised on a delicate balance, should have weighed into them respectively 227.84 grains, 455.69 grains, 1822.77 grains, and 3645.55 grains of distilled water at 60° Fahr. The place to which the liquid fills the measure on the neck should be carefully marked with a file, observing first to add a minute drop of a solution of bichloride of mercury in alcohol, which secures a perfectly level surface to the liquid. For smaller measures we need a tube of very uniform calibre, of about one-quarter inch in diameter, which should be closed at one end, then counterpoised as before explained; into this four and three-quarter grains of distilled water at 60° Fahr., the nearest approximate weight to five minims, should be weighed, and the place marked with a file; the same quantity of water should again be added, and the level marked. This should be repeated until twelve weighings have been noted; with this the minim measures and the small divisions of a graduated measure may be tested.

Hodgson's improvement, which consists of a moulded measure of precisely uniform size, is spoken of in the chapter on metrology.

Minim Measures.—For the division of a fluidrachm, the minim measure is employed. This is usually an upright cylinder of glass, with a lip at one extremity, and a glass pedestal at the other, and is graduated from sixty minims (one fluidrachm) to five minims. The kind used in fitting saddle-bags and physicians' pocket cases is made of glass tube with or without a foot, and does not occupy more space than an ordinary f℥ij tube vial. The inconvenience of employing a measure of this kind has led to the use of drops in prescription, instead of minims, and as essential oils and spirituous liquids drop so differently from aqueous liquids, and as the same liquid drops very differently from different vessels, great discrepancies occur, unless the dispenser sufficiently understands and observes the distinction. (See tables of approximate measurement in next chapter.)

Fig. 56.



Minim measure.

Tin Measures.—Tin, but preferably tinned copper, measures of half pint, one pint, or two pints capacity, will be found very useful to the dispensing physician, and indispensable to the pharmacist. They may be used for water, alcohol, syrups, and most tinctures, whenever the full quantity they will contain is prescribed.

Graduated measures of block tin, having ridges on their inner surfaces marking the quantities, are much used by German pharmacists, and are well adapted to many purposes, though rarely kept by dealers in chemical wares in this country.

Mortars.—Mortars are necessary in so many processes of pharmacy, as to be among the most important items of an outfit. I shall describe the kinds usually sold, with their different uses, leaving to the physician the choice of one or more varieties, according to circumstances.

Wedgewood mortars are largely manufactured in England, and an inferior quality of similar ware has been made in this country. They differ somewhat in their texture, though designed to have sufficient roughness or grit to adapt them to the powdering of substances by trituration. The best varieties are glazed enough to prevent their absorbing or becoming permanently stained by chemicals triturated in them, and yet are not so smooth as to allow substances to slip about instead of being retained under the pestle. At least one good wedgewood mortar is necessary. It should be of the shape indicated in Fig. 57, slightly hollow in the middle of its base, so that it will stand firm during the process, and furnished with a good lip. The pestle should be, in shape, precisely adapted to the interior surface of the mortar; neither flattened nor pointed at its

lower extremity. As the larger sized pestles always consist of two pieces, a wooden handle, and the rounded portion which is of wedgewood ware, care should be taken to have the connection be-

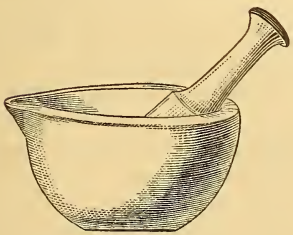
Fig. 57.

Wedgewood mortar and pestle.

tween them, which is made with cement, perfectly tight. When they become loosened, they may be secured by a cement made of resin, two parts; yellow wax, one part; and Spanish brown, three parts; melted together by heat.

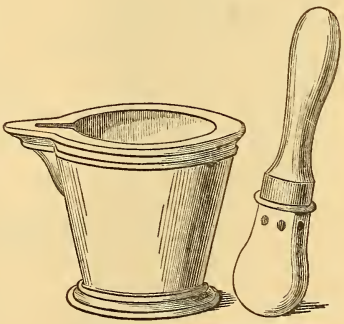
For the purpose of solution, a *porcelain mortar* is convenient; such are frequently more shallow than the wedgewood variety. They

Fig. 58.



Porcelain mortar.

Fig. 59.



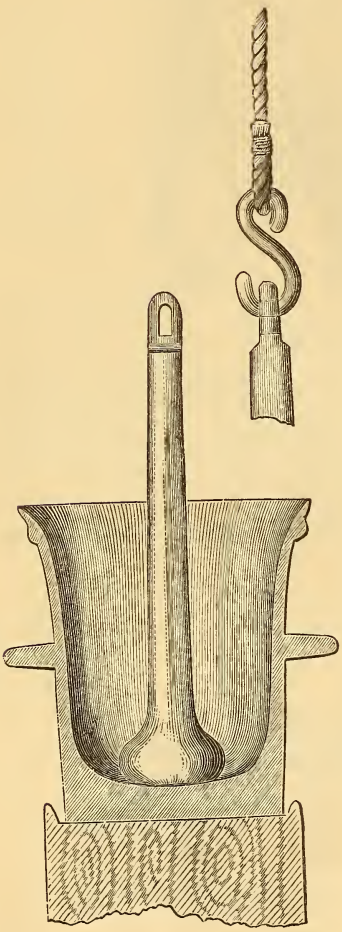
French porcelain mortar.

are perfectly smooth and highly glazed, and are not liable to be stained by chemical substances dissolved in them. They will also be found convenient in preparing such ointments and cerates as

require to be introduced into a mortar, being more readily cleansed than wedgewood ware. The one shown in Fig. 58 has a pestle of the same material. Fig. 59 represents a French porcelain mortar well adapted to many purposes, as making emulsions; the pestle, though having a handle of hard wood fitted to the porcelain part, requires no cement to secure them together; wooden plugs are fitted into holes in the porcelain and wood, which render the connection secure.

Glass mortars are frequently found in the office of the physician, and the shop of the apothecary. They are too soft for use in reducing hard substances to powder, but are adapted to forming solutions of readily soluble materials, and to use in making ointments. The small sizes are much employed in fitting up medicine-chests and medical saddle-bags. They are without doubt the best mortars for making solutions of the stronger alkaloids, and in using them the best plan is to place the mortar over a *black* surface, as most of the alkaloids are white or of light color, and triturate with the solvent until the solution has been effected.

Fig. 60.



Mortar and pestle for contusion.

The smoothness which occasions substances to slip about under the pestle in manipulating with glass mortars, may be overcome by grinding fine emery and oil of turpentine in them.

For large operations, as, for instance, in making syrup of bitter almonds, confection of roses, or mercurial ointment, a *marble mortar* is most convenient; a perfect block of hard and close-grained marble of requisite size is cut out into a shape adapted to trituration. The pestle is made of hard wood, or of the same material fastened upon a long wooden handle, which may be projected into an iron ring above, secured properly over the centre of the mortar, so that, while the operator gives the requisite grinding motion to the lower extremity of the pestle, the upper is held securely in its place; the use of this is, however, restricted to substances neither very hard nor of acid properties.

Mortars of the kinds above described are not adapted to contusing substances, either with a view to obtaining powders, or to employing them in a bruised condition. If used for this purpose, they are very apt to be broken on the first trial.

For contusion, an *iron*, *brass*, or *bell-metal mortar*, of the shape shown in Fig. 59, is best suited. Unlike mortars for trituration, these are somewhat flattened at the bottom, and the pestles terminate in a flattened ball; they are tall in proportion to their diameter, as seen in the drawing.

The laborious process of powdering drugs is greatly facilitated by the employment of mills; some of the varieties of coffee and spice mills met with in iron or hardware stores are exceedingly useful in the comminution of vegetable substances for the preparation of tinctures, infusions, etc., and even in their reduction to powder; one of these may well form part of an outfit.

To the physician who prepares his own powders, one or more sieves will be found very useful. The most permanent and desirable kind is that made of wire-gauze, though hair and bolting-cloth sieves are somewhat less costly; the latter answer very well if kept clear of moths. A sieve with a covering at top and bottom is preferable; these coverings should be made of leather, secured by hoops rather than of wood, which is liable to warp and crack.

Wire sieves are numbered by the manufacturers with reference to the number of wires in the linear inch, and the most desirable sizes, with reference to the preparation of tinctures and infusions, are Nos. 20, 40, 50, and 60. For separating powders to be taken in substance, the very finest sieves, as high as No. 80, are most desirable.

Spatulas.—Of these there are several kinds. The plain steel spatula, or palette knife, shown in Fig. 63, is, perhaps, best adapted to the general purposes of dispensing. In selecting them, care should be taken to have one very flexible, and another quite stiff, while, of course, they should be of two or more sizes. The balance handle spatula (Fig. 62) is also useful in dispensing operations,

Fig. 61.

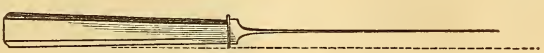
Fig. 62. 

Fig. 63.

being generally reserved for folding powders, and for other neat manipulations. It has the merit of lying on the table or counter without the blade coming in contact with it, a convenience when employed with pill masses or ointments. Three-inch spatulas may be made with a tapering blade, as shown in Fig. 61, so as to allow of

their being introduced into rather narrow-mouthed bottles, such as are usually put into saddle-bags and medicine chests.

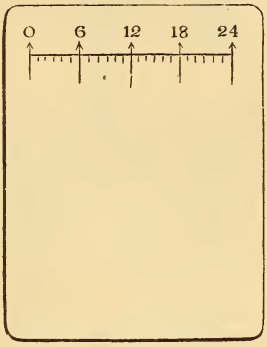
The frequent loosening and breaking of the handles of spatulas have led to an improvement in their manufacture, which consists of riveting the pieces of which the handle is made on to a piece of steel which is a continuation of the blade; these are by far the most durable spatulas that can be had.

When spatulas are broken, the remainder is often converted into a most serviceable instrument by grinding off the broken end to the shape of the original end of the spatula. This is very useful for manipulating with very firm extracts, etc. For further remarks see paper on this subject in *Proceedings of Amer. Pharm. Association* for 1865, p. 242.

Spatulas of glass, ivory, and bone are sometimes, though rarely, employed. They are useful in manipulating with corrosive substances which would act upon steel, and the latter is especially adapted to manipulations with ointment of nitrate of mercury, and certain other ointments, though well replaced by an easily prepared wooden utensil.

A *pill tile* (Fig. 64), made of porcelain or queensware, is useful in preparing certain ointments and pills. Tiles are made of various sizes, and are sometimes graduated, as seen in the drawing, to facilitate the division of masses into twelve or twenty-four pills.

Fig. 64.

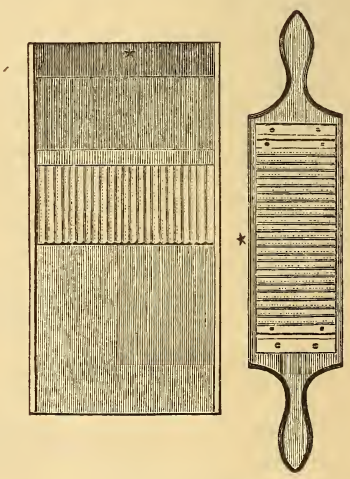


Graduated pill tile.

Fig. 65.

Pill roller.

Fig. 66.



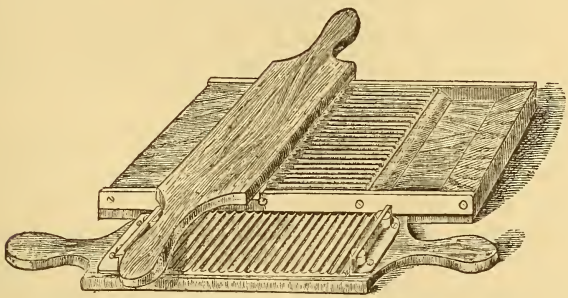
Wooden pill machine.

Fig. 65 shows a little implement adapted to rolling a pill mass on the tile or pill machine; it is made of wood, and furnished at a very inconsiderable cost.

The division of pill masses is best accomplished by the use of the machine shown in Figs. 66 and 67. These may be made of

wood or of brass, and adapted to sizes of pills, and to making one or two or more dozen pills at one time. In selecting them, care should be taken that they have been so manufactured as to cut the mass with precision, whichever way the roller is applied; most of

Fig. 67.



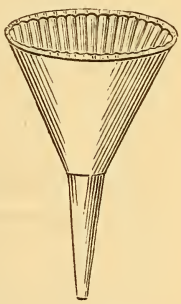
Brass pill machine.

those heretofore manufactured have been defective in this respect. Those manufactured by Wurtz, of Philadelphia, are the most perfect I have seen. The mode of using the machine is described in the chapter on Dispensing Medicines.

A pill machine patented by Mr. Wilson claims to be an improvement, by enabling the operator to make pills of various sizes by elevating the guides at the sides of the machine, thus forming a thicker or thinner cylinder, out of which to make the pills; the defect in the machine is, that, while the cylinder of mass varies, there is no correspondent variation in the size of the cutting plates; as one-fourth inch cutters require a cylinder of mass one-fifth of an inch in diameter, so must any change in the size of the mass be accompanied with a corresponding change in the cutters.

The *funnel*, sometimes called tunnel, is an article of every-day use in the dispensing shop or office, as well as in the laboratory. A porcelain or wedgewood funnel is represented by Fig. 68. The sides should be straight, and at an angle of 60° to each other. The tube should be smallest at its lowest extremity, and should have one or more grooves upon its outer surface, to allow of the egress of air from a bottle, into the mouth of which it is fitted. Funnels which are grooved on their inner surface are generally preferred for filtration, as allowing a more ready downward passage of the liquid, especially when the plain filter is employed. They may be made of glass, porcelain, Berlin or queensware, vulcanized rubber, and tin; those of glass are generally furnished physicians in their outfits; but the porcelain variety is far less liable to breakage, and is equally cleanly.

Fig. 68.



The porcelain funnel.

A very simple but useful improvement in glass funnels has been made of late years by grinding the smaller end of the neck off to an angle, as represented in Fig. 69. The liquid follows the neck to the lowest point, and does not have the tendency to flow back and close the space between the bottle neck and the tube of the funnel. For filtering volatile liquids the upper edge of the funnel should be ground to a level surface by rubbing on a flat stone with some fine emery; this renders a piece of plate glass a tight cover when placed properly over it.

Fig. 69.

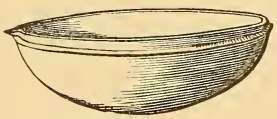
Improved glass funnel.

Gutta-percha or vulcanized rubber has the advantage of lightness and durability, and, not being affected by acids, leaves nothing to desire for the manufacture of a permanent funnel.

The *displacement apparatus* recommended in the previous editions of this work as almost indispensable to the pharmacist and physician, may be well replaced by a funnel in almost every small operation. For details of the mode of preparing displacement tubes extemporaneously and managing the process, see the chapter on Displacement or Percolation.

One or more *evaporating dishes* of Berlin or fine porcelain ware, and a porcelain cup (Fig. 71), will be found convenient in the pre-

Fig. 70.



Evaporating dish.

Fig. 71.

Porcelain cup.

Fig. 72.

Capsule.

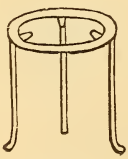
paration of many of the galenical and most of the chemical preparations appropriate to the office or shop. These dishes are of different prices according to quality, and range from the two gallon to the one fluidounce size.

The *flask* (Fig. 73) is a cheap and convenient implement for small operations requiring heat, and especially for forming solutions of saline ingredients.

Fig. 73.

Flask.

Fig. 74.



Tripod.

The *tripod* (Fig. 74), or a retort stand, sold by dealers in apparatus, should not be forgotten, as being necessary to the convenient use of the foregoing.

Vials.—The physician's outfit usually contains from half a gross to a gross of prescription vials, varying in size from f℥viij to f℥ss. As more of the smaller sizes are used than of the others, it is desirable to have about the following proportions in a gross: One doz. f℥viij, one doz. f℥vj, two doz. f℥iv, three doz. f℥ij, three doz.

f℥j, two doz. f℥ss, though usually a larger number of the two smaller sizes are introduced at the expense of the three largest sizes. Several of the larger sizes should have wide mouths, for convenience in bottling solid substances, and also to adapt to the displacement apparatus.

A few vials of half drachm, one drachm, and two drachms capacity are very desirable for articles dispensed in these small quantities. Vials in commerce are classified as flint, German flint, and green glass; as fluted and plain; and as long and short. Flint vials are considerably more expensive than the green; though they are far more elegant for prescription purposes. They are generally made in a mould. Of the fluted vials, the long (Fig. 75) are the most convenient for ordinary purposes; they admit of a larger label being pasted on them, which is sometimes desirable in case of prescriptions, and they are more convenient for medicines that are to be administered by drops.

Fig. 76 represents a short fluted vial of the same size, and having a wide mouth, adapting it to solid substances. Fig. 77 is a flint

Fig. 75.

Fluted long prescription vial, of flint glass.

Fig. 76.

Wide-mouthed flint fluted vial.

Fig. 77.

Plain prescription vial, of flint glass.

vial, now very much in vogue, intermediate between the two preceding in height, and without the fluted surface; these are apt to show a crease down their whole length, at the point where the two halves of the mould in which they are made come together in shutting it, a common feature in all bottles made in moulds which open and shut by what may be called a lateral suture. Figs. 78, 79, and 80 represent vials blown without a mould, or in an open clay mould, and finished by hand. These have a handsomer and smoother surface, though less regular and uniform in shape, as here the shape depends on the skill of the finisher, not on the construction of his tools. German flint vials are intermediate in price between those of flint and common green glass. They are very well adapted to ordinary dispensing purposes, and, as made by our best manufacturers, leave little to desire.

The shape of the lip is one of the most important considerations in the selection of vials; if the lip is too narrow or rounded, a constant source of annoyance will occur from the liquid trickling down the neck and sides of the vial after pouring from it, and it will be impossible to drop from it at all. Figs. 79 and 80 represent the old-fashioned cheap green glass blown vials; the vial shown in

Fig. 79 has the disadvantage of not standing up, and is usually suspended by a string. Those who have the *Proceedings of the American Pharmaceutical Association* at hand (vols. xvii. 355; xx. 90) will find several papers upon glassware, which will give information upon this whole subject.

Fig. 78.

Plain German flint vial.

Fig. 79.

Old-fashioned long green vial.

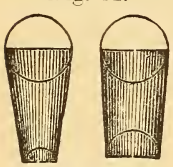
Fig. 80.

Short prescription vial, green glass.

A few colored vials may be advantageously introduced into an outfit for use in dispensing solutions of nitrate of silver, or other solutions decomposable by light. Some pharmacists adopt the plan of dispensing poisonous preparations and liquids, designed for external use, in vials of peculiar shapes or colors, for the sake of distinction. The disadvantages of any attempt to substitute precautions of this kind, for that constant vigilance in regard to medicines which is the only safeguard of the public, must have occurred to every person of experience.

Corks.—These are exceedingly variable in quality; the softest and most perfectly shaped varieties, though expensive, are so far preferable for use as to make them cheaper in the end. Tapering or "homœopathic" corks possess the advantage of being fitted to vials of various sized necks with great facility, and if sufficiently "velvety," will bear thrusting tightly and securely into their place. These remarks are equally true of the larger sizes, called bottle corks; of these we have pint corks, quart corks, demijohn corks, and flat or pot corks, the last being used chiefly for wide-mouth packing bottles and earthen jars. There is a variety called "citrate corks," introduced since the invention of citrate of magnesia solution, very uniform in size and quality, and an improvement on the ordinary pint corks. It is well to be supplied with a few of these, though vial corks constitute by far the largest proportion of the number required.

Fig. 81.



Tapering and straight corks.

Among the numerous gum-elastic implements which have come into use within a few years are suitably shaped stoppers, adapted to bottles of various sizes. These are not liable to the same objections which apply to corks; they are not acted upon by the strong acids or alkalies nor by iodine. They are, however, comparatively

expensive, and their surface is not so well adapted to the purpose as the soft, velvety surface of cork.

Paper of different kinds should not be overlooked in making up an outfit. The most useful is druggist's white wrapping-paper, which should be fine without being heavy or spongy in its texture; it should not crack at the edges when turned over sharply; this paper is that sold to printers ordinarily; it should be well calendered, so that the various materials will not adhere to it. The sizes met with in commerce are medium, about 19 × 24 inches, and double medium, 24 × 38 inches. The price of this paper is generally in proportion to its weight. It varies in the Philadelphia market from 12½ to 20 cents per pound, varying with the quality and with the relation of supply and demand. For directions in regard to dividing the sheets, for dispensing medicines in packages, see chapter on Dispensing.

The kind of paper called flat cap will be found very convenient in addition to the above, especially for putting up powders in small doses.

Filtering paper should be without color, and of a porous texture, and yet sufficiently firm to sustain the weight of the liquid placed upon it. The market is now freely supplied with a superior article in circular sheets, called French filters. Swedish filtering paper is the very best, and is preferred for analytical processes; it is, however, too expensive for common use in the shop.

Envelope paper, though not white, and hence seldom used for ordinary dispensing purposes, is extremely useful as an outer wrapper to packages requiring additional security.

Fancy paper, employed for capping corks, or as a very nice outer wrapping to packages, is recommended to those who desire to practise neatness and elegance in dispensing. *Tin-foil* is also required for covering jars of ointment, deliquescent powders, etc.

Pill Boxes.—These are of three kinds: 1st. Paper pill boxes, adapted to dispensing pills. 2d. Wooden pill boxes, or chip boxes, made of shavings, and best suited for ointments, confections, etc.; of this article, a very beautiful style is imported from England, which commands nearly double the price of the American kind. The most perfect chip box yet produced is that made by rolling a thin shaving of wood around a steel mandrel, and coating the surface of the shaving with glue; when this has set, a second shaving is glued upon the first, the grain being reversed; after drying, the bottom and top, both of double thicknesses of shaving glued together, are glued into their places; this box is impervious to grease and varnish, and will resist much hard handling. 3d. Turned boxes, which have been recently introduced for dispensing pills, and are certainly more substantial than either paper or chip boxes. They do not, however, serve so good a purpose for ointments; the bottom, being cut across the grain of the wood, soon becomes saturated with the grease, and soils everything it is set upon. When

Fig. 82.

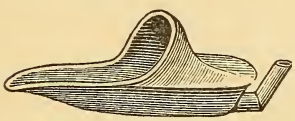
Neck pill boxes.

these boxes are used for ointments, they should be lined with a good coating of glue, put on hot. Pill boxes are usually sold by the dozen nests, wrapped in paper. Sometimes a nest contains three, and sometimes four boxes, ranging from about an ounce capacity to one-fourth that size. A new pattern of paper pill box, recently introduced in the best pharmaceutical establishments, is here figured. It is made with a shoulder; the top and bottom overlap the edges, so that they cannot be forced in by ordinary pressure. The diameter being large in proportion to the depth, they are conveniently carried in the waistcoat pocket.

The physician should provide himself with a tin case, in the shape of a closed cylinder, in which to carry his gum catheters and bougies, and another for adhesive plaster cloth, which otherwise is liable to become useless in our climate.

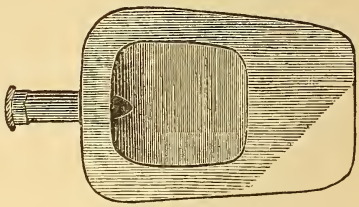
In severe illness, and especially after confinement, patients are frequently so situated as to be unable to be moved without great

Fig. 83.



Slipper bed-pan.

Fig. 84.

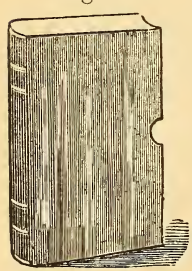


Covered bed-pan.

inconvenience and danger, and a variety of urinals and bed-pans have been contrived. "*The slipper*," made of tin, upon the plan of Dr. Jos. Warrington, is adapted to the use of females, and is certainly an improvement upon any contrivance for the purpose. It is of precisely the shape best adapted to slip in between the thighs and under the lower extremity of the back, without pain, and to receive the evacuations, whether alvine or urinal, without the danger of soiling the sheets.

The *bed-pan* of planished tin, Fig. 84, is a wedge-shaped receptacle neatly covered by a movable lid, while the tubule is effectually closed by a brass screw, facilitating the complete closure of the apparatus till its removal from the apartment.

Fig. 85.



Pamphlet case.

Among the useful additions to the physician's and pharmacist's outfit is the pamphlet case here figured. It consists of a tin case of the size of a large octave volume, adapted to receiving and preserving the journals and other unbound publications, which will accumulate on the hands of any one who is properly alive to the current

literature of his profession. By having several of these, one can be appropriated to each of the periodical issues, and one reserved for the occasional pamphlets, price currents, etc. At the end of the year, their contents may be sent to the binder, or tied in packages and laid away.

In the selection of implements and utensils of all kinds, it should ever be remembered that those of the most durable materials and thorough workmanship are the most economical, giving satisfaction while in use, and often being valuable as old material when no longer fit for the purposes for which they were obtained.

The other items to be mentioned are a few pieces of fine Turkey sponge for surgical use, and one for the inhalation of ether, if a friend to anæsthesia in surgery and obstetrics; a corkscrew, a ball of fine linen twine, a pair of scissors, a few coarse towels for wiping mortars, a tin cup for heating liquids, a sheepskin for spreading plasters, etc.

The apparatus and furniture here described are such as may be regarded as necessary to the outfit of a country practitioner. I shall find occasion, in the subsequent parts of this work, to refer to many implements which it would be superfluous to describe in this place, though frequently included in the outfit.

CHAPTER II.

CELLAR, STORE-ROOM, AND LABORATORY.

The cellar is an important part of the drug store, and yet some pharmacists, from their location, are debarred from any but very small underground accommodations.

If large, dry, and light, the cellar will supplement the ground floor for important storage and laboratory uses. Besides the fuel, the ash-pit, the soda-water fountain, and ice-chest, it may contain the screw press, drug mill, mortar for contusion, packing material, boxes, shelving, drawers, and working counter.

In some of the city stores, where the value of real estate prevents much extension of the ground floor, the cellar is made use of as a laboratory, being extended under the pavement as well as under the store. In some wholesale establishments a steam-boiler, steam-engine, stills, evaporating pans with stirrers, also blue-mass mill, plaster machine, or any similar apparatus required by the nature of the business, are located in the cellar. The disadvantages of this arrangement are, the strong odor of the evaporating liquids pervading the store, the jarring motion from the proximity of the machinery when in use, and the increased danger of an accidental fire in the basement, involving the destruction of the whole building and its valuable contents.

For the purposes of a retail business carried on in a building also occupied as a dwelling, a suitable portion of the cellar should be separated by a brick partition from that used by the family, and if practicable vaults should be dug, one for the coal bins and the other for the storage of highly inflammable liquids; this should communicate with the cellar by a passage, and a direct and easy ascent should be provided to the street and to the store.

Upon the shelves, which should be situated in the coolest part of the cellar, and lighted by gas at night and if necessary during the day, should be arranged gallon, half-gallon, quart, and pint packing bottles, to hold the full quantities of the respective waters, tinctures, spirits, syrups, fluid extracts, and similar preparations which the demands of the business require to be made or bought at one time, so as to replenish the furniture bottles in the store. It will be impossible, in organizing a new store, to make exactly the quantities required, and in the developments of the business these will probably be modified, if not uniformly increased. In the absence of experience, the best rule to follow as to quantities is probably that of the United States Pharmacopœia, which generally directs about the quantity of each preparation appropriate to a retail store. Doubtless many beginners have found their first outfit to last much longer than they expected, but, on the other hand, it is very promotive of business to have enough in stock to supply any unexpected demand, and to be able, without delay, to replenish the furniture bottle at any time that it may be emptied. There is no better place to keep this class of goods than a cellar of a low and nearly uniform temperature the year round, out of the reach of a strong sunlight, though not so dark as to render the reading difficult.

The drawers and other receptacles in the cellar are adapted to the extra stock of sponges, corks, vials, bottles, jars, and similar articles for which there is not space in the store. Here baskets of sweet oil, boxes of Saratoga and other mineral waters, and barrels of whiting, rotten-stone, and the like, may also be kept—care being taken not to encumber any unoccupied corner with materials out of sight, and consequently likely to be forgotten.

The cellar need not be plastered, and the joists will then afford support to narrow shelves, nailed on to their lower edge, which may be labelled on the under side so as to be easily read from below. These shelves will be appropriate depositories for such vials of volatile oils, syrup of iodide of iron, jars of pomade, and duplicate small packages as it is desirable to keep out of the light and heat of the store. The cellar may advantageously contain a heater, such as is now so extensively introduced into basements; and if the demands of the store and upper rooms are moderate, one placed in a central position in the cellar, though designed to supply warm air to the store and upper rooms, will diffuse sufficient warmth around it to take off the dampness, which constitutes the greatest objection to an under-ground place of storage.

In cellars and vaults the labels of the bottles and other permanent

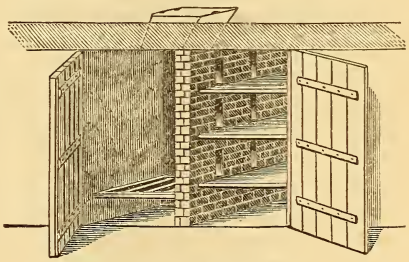
receptacles of surplus stock should be written with black varnish, as they are not if thus marked liable to become obscure by fading as when lettered with ink; and the moulding of the paper, in the absence of a better material, can be prevented by washing it with a solution of corrosive sublimate.

As a general rule, packages of chemicals which are in the least deliquescent, or of vegetable substances, whole or powdered, unless in tight glass or metal, are unsuited to storage in the cellar; but by weather-boarding the walls, or lining them with studding and lath and plaster, flooring with boards laid upon joist, and ventilating suitably, and warming with stove or furnace, a dry, very satisfactory, and comfortable store-room and laboratory may be obtained under the store.

If there is a *vault*, it should have shelving for bottles or demi-johns of ether, Hoffmann's anodyne, benzine, gasoline, and, if the cellar is warm, for the fruit juices and the more easily fermentable syrups, and for the summer supply of lard and certain ointments which require to be kept cold. The alcohol barrel and any carboys of acid or ammonia may have stands under the shelving, or in another part of the vault. As it is not desirable to introduce artificial light into the vault, bull's-eye glasses or the patent vault lights may be advantageously placed in the crown of the vault to light it during the day, and a similar glass may be cemented into a hole pierced in the wall, which will supply artificial light from the cellar at other times.

An *ice vault* or chest is almost indispensable to a pharmaceutical store in the climate of the United States. If carbonic acid water is sold on draught, the ice supply is of sufficient importance to claim special arrangements for its preservation, and, in connection with this, means of refrigeration for fermentable liquids and bottled mineral waters should be provided. A vault communicating with the cellar and with an opening from the street may contain an ice closet such as is shown in Fig. 86; it is provided with a shoot and an opening from the street for the delivery of the ice into a box with a heavy wooden slat floor perforated, or on a slant, so that the melted ice will flow off as soon as produced. Under this a metal or slate-lined box may be placed to receive any articles not injured by moisture which require to be brought to a temperature nearly approaching the melting point of ice. Adjoining the ice-box is a closet in which syrups, cream to be used in connection with the soda-water syrups, lard, and any preparations which require to be kept uniformly cold, may be set away upon shelves. Slate is a good material for lining such a closet and for constructing the shelves.

Fig. 86.



Ice vault and closet.

There should be small openings between the ice-box and the closet to promote the circulation of air. There may also be a pipe connecting with a flue so as to draw in a current of air from the ice through the refrigerator; but this will increase the melting of the ice, which is generally to be guarded against. Large refrigerating vaults are sometimes constructed on this principle, in contact with ice-houses, a few bricks being left out near the bottom of the partition between them; but it is not practicable to keep large quantities of ice under the pavement in the city from season to season. A large bulk, not less than sixteen feet square and nearly the same depth, is considered the least quantity that will keep well.

The *Pharmaceutical Laboratory*, erected for the manufacture of the varied products of our art in large quantities, to meet an extensive wholesale demand, should be in the suburbs or manufacturing quarter of a large city, or in some readily accessible rural district; while a retail or dispensing store requires a location either on a business thoroughfare where it can attract transient custom, or in the midst of the dwellings of the people; and yet in some instances these two are so far combined that a laboratory of considerable size is directly attached to the dispensing store.

This work is not written for the very few whose aim is to devote themselves to manufacturing pharmacy, or to one or other of the numerous specialties into which it is divided, so much as for the many whose chief business is to retail medicines over the counter, and to prepare for their own sales the numerous officinal and unofficinal preparations prescribed by physicians and demanded by the public.

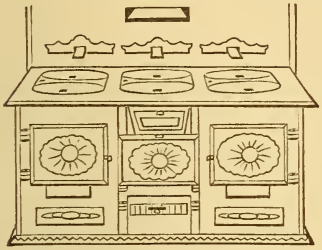
A comprehensive treatise on manufacturing pharmacy, giving the best forms of apparatus for large operations, and the details of the numerous processes, with reference to economy and perfect success, is a desideratum; but it would pay neither the author nor the publisher for the great labor and expense it would involve, because it would not meet an extensive demand.

The reader will be more profited by suggestions as to the arrangement of an apartment for producing pharmaceutical preparations in such quantities as are demanded by a dispensing store. The location of this store will be regulated by circumstances. The cellar has been already referred to as readily accessible from the store, and on that account desirable; but a location on the ground floor is in all respects to be preferred, and the top story is the next in eligibility; here all noxious gases and the disagreeable vapors given off in evaporation are readily dissipated without annoyance, and in case of accident from fire, the destruction of the building is not so imminent.

In the event of locating a laboratory up stairs, it should have a hatchway and tackle for the conveyance of heavy packages; and if steam is to be used as the means of heating, the boiler should be located in the cellar or on the ground floor, and should communicate with the laboratory by a steam pipe, which, with the water supply, waste pipe, and drip from the evaporating pans, should run

inside the walls or up and down a warm air flue, so as to avoid the danger of freezing in winter. The floor should be covered by tile or slate set in cement, and should slope in the direction of the corner in which the waste pipe takes its origin; here a sink may be let into the floor to collect the drippings. The laboratory may contain a kitchen range set in the chimney, with a water-back, which, in the absence of a steam boiler in the cellar, will give a limited supply of hot water for use wherever needed. To the store itself such a range is a useful addition, provided there is room to locate it out of sight of customers and in connection with a good flue. Fig. 87 shows a good range for pharmaceutical

Fig. 87.



Range for store and laboratory.

Fig. 88.

Stove for similar uses.

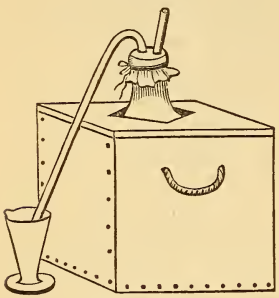
purposes. It furnishes accommodation for two vessels the contents of which can be kept boiling rapidly, while four others can be heated to different temperatures; the ovens at either side will enable the operator to desiccate articles at the same time. In the absence of a kitchen range, a cooking stove will serve a good purpose, and may be arranged as shown in Fig. 88. The top will accommodate four vessels at one time, and in the oven a number of articles may be gradually dried; a sand-bath can be readily attached to this by causing the smoke and products of combustion to traverse a flat iron pipe before reaching the chimney; upon the upper side of this pipe a flange is turned up an inch or two all around, in which space the sand is to be placed.

Although it is undesirable that the laboratory should be used for general storage, yet most of the substances to be employed in making the various preparations should be near at hand. If practicable, a store-room should adjoin the laboratory and communicate with it by a door, otherwise the wall on at least one side should be lined with shelves of sufficient width and at such distances apart as to admit of 2 gall., 1 gall., and ½ gall. bottles, demijohns, tin cans, and stoneware jars, containing the leading articles demanded in the course of the manufacturing processes. The products will mostly be stored in the cellar when completed, and the alcohol supply, where received in barrels, may be emptied into cans and apportioned between the cellar and laboratory. The alcohol distillates collected in the process of concentration of extracts and fluid extracts, suited only to the same use again, will each need a

separate can or bottle. If the cheap mineral acids, ammonia, or glycerine are purchased in carboys, they may be placed under the shelving on a platform elevated about fifteen inches from the floor. A barrel of sugar will be needed, and should have an appropriate place allotted to it. Besides a counter like that already figured on page 38 (which may be greatly extended), there should be one for weighing, on which the laboratory scales should be kept. Processes in which fluids are used should be separated from those requiring perfect dryness; in fact, the folding of Seidlitz powders, the putting up of toilet powders and dentifrices, and similar operations, which are largely pursued in some stores, are unsuited to the laboratory.

Heavy percolators should stand on separate frames, and be supported by iron bolts fastened firmly to the sides and resting in holes in the frames, just high enough to allow of conveniently packing them, with room to draw off the percolate below. This permits their being inverted when the percolation is complete. A large box, suitable for convenient removal, should be always at hand for the reception of *débris*, which will rapidly accumulate; into this the ashes and sweepings may be thrown; and a separate barrel for broken glass will bring a small revenue.

Fig. 89.



Carboy siphon.

Fig. 89 shows a carboy and siphon arrangement invented by Chas. Bullock, of Philadelphia, for drawing off acids, ammonia, and other liquids.

This arrangement consists of a cap of stout sheet caoutchouc with two apertures, which are prolonged into small tubes, one of a size sufficient to permit the siphon tube to pass. The other, through which a small tube passes a few inches into the neck of the carboy, is smaller. The cap is fastened airtight around both the tubes, and covers the outside of the neck of the carboy, around which it also is fastened airtight. Upon blowing steadily into the small tube, a pressure is exerted on the surface of the liquid, and it finds exit through the siphon, which continues in action until stopped by some appropriate cause.

PART II.

CHAPTER I.

ON PHARMACOPŒIAS.

Ever since medicine has been cultivated as a liberal profession, the necessity has been increasingly recognized of definite and authoritative standards to regulate the strength and purity of medicines; hence the adoption of Pharmacopœias. In most European countries the Pharmacopœias have the authority of law, being edited by learned men appointed to the service by the respective governments. In the United States, where the State and national governments interfere but little with professional pursuits further than to grant acts of incorporation to organizations representing the several professions, the Pharmacopœia originates with the medical and pharmaceutical colleges. Although each country possessing a Pharmacopœia properly gives preference to its own, the mixed character of the floating population in all countries requires some acquaintance on the part of well-educated pharmacists with the officinal standards of other countries. A Universal Pharmacopœia is a compendium of all the Pharmacopœias for comparison and reference to formulas and synonyms. The last issued is that of Jourdan, published in Paris, 1828. In it are formulas from more than thirty Pharmacopœias, nearly all of which are national, a few only being limited to military or hospital purposes. Some of these have since been consolidated, as the London, Edinburgh, and Dublin into the British. The more important of those existing, omitting these three, are given in the following list, with their dates:—

List of Pharmacopœias.

The Pharmacopœias denoted by the asterisk * have been superseded by the German.

	Pharmacopœia Austriaca	Vienna.
1792.	Pharmacopœia Amstelodamensis Nova	Amsterdam.
1850.	Pharmacopœia Batava	Amsterdam.
1859.	Pharmacopœia Bavarica	Munich.*
1856.	Pharmacopœia Belgica	La Haye.
1868.	Pharmacopœia Danica	Copenhagen.
1777.	Dispensatorium Pharmaceuticum Brunsvicence .	Brunswick.*
	Pharmacopœia Hispana	Madrid.
1866.	Codex Medicamentarius sive Pharmacopœia Gallica	Paris.

1825.	Pharmacopœia Ferrarese	Padua.
1850.	Pharmacopœia Fennica	Abo.
1791.	Pharmacopœia Fuldense	Frankfort sur le Main.*
1780.	Pharmacopœia Genevensis (Swiss)	Genève.
1804.	Pharmacopœia Pauperum in usum Instituti Clinica Hambergensis. (Not in use.)	Hambourg.
1831.	Pharmacopœia Hannoverana	Hanover.*
1827.	Dispensatorium Electorale Hessiacum	Marbourg.*
1794.	Dispensatorium Lippiacum genio Moderno Accommodatum	Lenigo.*
1801.	Pharmacopœia Oldenbergica	Oldenbourg.*
1826.	Pharmacopœia Lusitanica	Lisbonne.
1764.	Dispensatorium Medico Pharmaceuticum Palatinatus	Manheim.*
1817.	Pharmacopœia Regni Poloniæ	Varsovie.*
1822.	Pharmacopœia Castrensis Borussica	Kœnigsburg.*
1862.	Pharmacopœia Borussica	Berlin.*
	Pharmacopœia Rossica	St. Petersburg.
1837.	Pharmacopœia Saxonica	Dresden.*
1773.	Pharmacopœia Sardoa	Turin.
	Pharmacopœia Suecica	Stockholm.
1847.	Pharmacopœia Wurtembergica	Stuttgard.*
1796.	Pharmacopœia Herbipolitana	Wurzbourg.*
1815.	Pharmacopœia in usum Noiscomii Militaris Wurzburgensis	Wurzbourg.
1870.	Pharmacopœia Norwegica	Christiania.
1872.	Pharmacopœia Helvetica	
1872.	Pharmacopœia Germanica	Berlin.

The mere enumeration of the different Pharmacopœias will show the great necessity there exists for one which shall have a *quasi* legal authority in a country the population of which is so mixed as that of the United States, and it also demonstrates the impossibility of having all the formulas of the various Pharmacopœias consolidated into one for ourselves. The Pharmacopœia is not to be looked to as a guide to novelties in Pharmacy, but as an authoritative rule by which to prepare those remedies which time and experience of the medical and pharmaceutical professions have determined to be of such utility as to deserve a place in the national code of medical formulæ.

The origin and manner in which our own Pharmacopœia was brought into notice are now so well known that any history is unnecessary; it is only proper to say that the national convention, which authorizes its issue, provides for a stated (decennial) revision of it, thus enabling the professions interested to have a definite time to report their varied experience with the formulas already authorized, and to prepare new ones when they feel that such are required, either by the failure of the old ones or the omission of such as had not been sufficiently proven to be useful.

The Pharmacopœial Convention of 1860 contained delegates from Medical and Pharmaceutical organizations in seven States and the District of Columbia, and from the army and navy of the United States. Its sessions were held in Washington, and the Committee of Revision of Publication, which contained a majority of practical pharmacists, met as heretofore in Philadelphia. The fourth

decennial revision was not completed till the summer of 1863, when the *Pharmacopœia* was published; the last revision of this Text Book, in part a commentary upon it, was immediately matured and put to press. Allusion has been made to the *U. S. Dispensatory* as having contributed largely to the establishment of the authority of our national standard, while it has promoted the diffusion of medical and pharmaceutical knowledge. It remains to define the comparative utility of the *Pharmacopœia* and *Dispensatory*, especially as so many students confound the two works with each other. Every physician who practises pharmacy, as most country practitioners do, and every druggist and apothecary, should possess a copy of each of these works; the *Pharmacopœia* for use as a guide-book in making officinal preparations, and the *Dispensatory* for reference as an encyclopedia of materia medica, therapeutics, and pharmacy.

The conciseness and brevity of the *Pharmacopœia*, the clear and conspicuous type, and the absence of unnecessary detail adapt it especially to the purpose of indicating the ingredients, the proportions, and the mode of putting up the officinal preparations. Liability to mistakes is greatly lessened by the clearness and accuracy of a recipe, which should always be open before the operator, and should be continually consulted in the course of his manipulations.

It will be in place to explain, in this connection, the use of the term *Officinal* in this work. While by some this word is meant to apply to all permanent preparations, by others it has an application to those only which are spoken of in the *Dispensatory* or in foreign *Pharmacopœias*. In this work the use of the term is restricted to drugs and preparations mentioned in the *U. S. Pharmacopœia*, and I have distinguished these throughout the work from such as are omitted from that standard; this is the only limit of the term *officinal* which renders it definite and precise, and with this meaning it certainly is most useful in a work like the present.

The Pharmacopœias of London, Edinburgh, and Dublin, which were formerly much used in this country, and constituted the standards for the British empire, have been superseded by one consolidated *British Pharmacopœia*, and it was the design in the third edition of this work to introduce all the formulæ of that, together with our own; the long delay in the revision, consequent on the disagreement on the vexed question of weights and measures, has prevented this, and somewhat limited the sphere of the last edition. Many of the formulas of this Pharmacopœia and its various directions are embodied in this edition, and where change has been made it will be noted.

Some idea of the plan of the U. S. Pharmacopœia, and especially of the principles of nomenclature adopted in it, may be drawn from the following selections from the preface of the edition of 1850:—

"The contents of the work are arranged in the two divisions of Materia Medica and Preparations; the former enumerating and defining medicines as they are derived from nature, or furnished by

the manufacturer, the latter containing formulæ, or rules, by which they are prepared for use.

"Both in the Materia Medica and the Preparations, the alphabetical arrangement has been adopted. In a work intended not for regular perusal but for occasional reference, it has the great merit of convenience. It has, moreover, the advantage that, making no claim to scientific classification, it is not liable to the charge of failure, so often and so justly urged against more ambitious systems.

"The Pharmacopœia was originally published both in the Latin and English languages. This was, at the time, an innovation upon general usage; as codes of this kind had been almost always issued by the dignified bodies from which they emanated exclusively in the Latin, which was considered as the language of science. In the revision of 1840, the Latin was dropped; as it did not offer advantages equivalent to the trouble of adapting a dead language to facts and processes for which it had no terms, and to the double cost of the work which it occasioned. The Latin names, however, of the medicines and preparations have been retained, and they are still generally, and often very conveniently, used in prescriptions; and it is desirable that medicines should have designations by which they may be recognized in all civilized countries.

"The system of nomenclature of the Pharmacopœia of the United States is one of its chief merits. Adopted at a period when it was without example in other works of the kind, and improved with each successive revision, it now prevails to a considerable extent in all the Pharmaceutical codes recognized where our vernacular tongue is spoken. Its aim is to be simple, expressive, distinctive, and convenient. In relation to medicines of vegetable origin, it adopts for those which have been long and well known, the names by which they have at all times been recognized, and which have withstood, and will no doubt continue to withstand, all the mutations of science. In this category are such titles as *Ammoniacum*, *Camphora*, *Galla*, *Opium*, *Senna*, etc. For medicines of more recent origin, which had received no distinctive officinal designation, it takes either the generic or specific title of the plant or animal from which the medicine is derived. Thus, we have the generic names *Anthemis* from Anthemis nobilis, *Chimaphila* from Chimaphila umbellata, *Eupatorium* from Eupatorium perfoliatum, *Gillenia* from Gillenia trifoliata, *Lobelia* from Lobelia inflata, etc.; and the specific names, *Senega* from Polygala senega, *Serpentaria* from Aristolochia serpentaria, *Taraxacum* from Leontodon taraxacum (now Taraxacum densleonis), etc. A very large proportion of the names have been formed in this way; and as the generic or specific title of the plant had its origin, in many instances, in the vernacular name, the original designation is thus fixed and perpetuated.

"When it happens that two different medicines are obtained from different species of the same genus, it becomes necessary to adopt either for both, the whole botanical title of the plants, or for one of them the generic or specific name, and for the other the whole

name. Thus we have *Cassia Fistula* and *Cassia Marilandica*, *Quercus alba* and *Quercus tinctoria*, as titles both for the plants and their medicinal products; and, in the case of the different species of Gentiana, the generic name *Gentiana* for the product of G. lutea, and the whole name, *Gentiana Catesbæi*, for that of the species designated in scientific arrangements. When different parts of the same plant are recognized as distinct medicines, they are designated by attaching to the generic or specific title the name of the part employed. Thus are formed the names *Colchici Radix* and *Colchici Semen* from Colchicum autumnale, and *Stramonii Folia*, *Stramonii Radix*, and *Stramonii Semen* from Datura Stramonium. When these names become established in pharmacy, it does not follow that they are to be changed with the changing scientific titles. On the contrary, it is generally best to retain them, unless, by doing so, injurious confusion may be occasioned. Thus we have *Prunus Virginiana* as the name of wild-cherry bark, though the tree from which it is derived is now usually designated by botanists as *Cerasus serotina*. It will be noticed that the Latin names are generally used in the singular number, even though the idea of plurality may be essentially connected with the medicine. Thus, *Cantharis*, *Caryophyllus*, *Ficus*, *Galla*, *Limon*, etc. are used instead of the plural of these terms respectively; and, in reference to the names derived from the part of the plant employed, the same plan is mostly followed, as in the case of *Stramonii Semen*, *Colchici Semen*, etc. In this the example of the Roman medical writers, particularly of Celsus, has been followed.

"In the use of English names, it is not deemed necessary that they should be literal translations of the Latin terms; but that title is preferred which custom and the genius of the language seem to sanction. Thus, the English name corresponding to *Linum* is not *flax*, but *Flaxseed;* and, on the same principle, *Fœniculum* is called *Fennel-seed; Ulmus*, *Slippery Elm Bark; Glycyrrhiza*, *Liquorice Root*, etc. Nor are the English names always in the same number as the Latin. We may correctly say, *Caryophyllus*, *Galla*, *Prunum*, and *Rosa;* but the genius of our language requires that we should translate these terms *Cloves*, *Galls*, *Prunes*, and *Roses*.

"The plan of nomenclature in relation to medicines of mineral origin is to give the proper scientific name, when convenience or some higher principle does not call for a deviation from that rule. Hence, the names of most mineral medicines are in strict accordance with existing scientific usage. But, in some instances, short and old established names are preferred to the scientific, especially when these happen to be somewhat unwieldy. Thus, *Alumen*, *Calamina*, and *Creta* have been preferred to the chemical names *Aluminæ et Potassæ Sulphas*, *Zinci*, *Carbonas Impurus*, and *Calcis Carbonas Mollis*. In other instances the chemical designation is more or less unsettled, or the composition of the substance has not been decisively determined. In such cases, either an old name is retained, as *Acidum Muriaticum* instead of either *Acidum Hydrochloricum* or *Acidum Chlorohydricum;* or some name is preferred

generally expressive of the composition without aiming at chemical accuracy, as *Calx Chlorinata*, taken from the London Pharmacopœia, and *Ferrum Ammoniatum*.

"In other cases, it is considered safest to designate very active medicines, which, if their strict chemical titles were used, might be dangerously confounded, by names which, though upon the chemical basis, have some epithet attached expressive of their distinctive character, as *mild chloride of mercury* and *corrosive chloride of mercury*, instead of *protochloride of mercury* and *bichloride of mercury*. Sometimes, for convenience sake, when no risk of confusion can possibly arise, names are adopted sufficiently expressive of the nature of the substance, though not precisely so; as *sulphate of iron* instead of *sulphate of protoxide of iron*, *hydrated oxide of iron* instead of *hydrated sesquioxide of iron*, etc. If any part of the nomenclature of mineral bodies should seem at first sight somewhat incongruous, it will be found to have been adopted in accordance with some one of the principles here stated, or in some other way to have the advantage of convenience or utility. Not a single name has been given or retained without careful consideration."

The nomenclature of the last edition of our Pharmacopœia has been changed somewhat, to render it more consistent with itself and more in accordance with the progress of chemical teachings. Formerly it was the usage of the Pharmacopœia to allude to *sulphate of protoxide of iron* as *ferri sulphas*, while the corresponding salt of sodium or potassium was termed *sulphate of soda* or *sulphate of potassa*, a distinction perfectly recognized by chemists a few years ago, but now the term used is *sulphate of potassium* or *sodium;* this method has the advantage of uniformity, and does not attempt to define the mode of combination at all, and so may be considered more permanent than a method which attempted to decide what different and equally good authorities considered unsettled questions.

"When the officinal names of particular medicines may be supposed not to have yet become universally known, and the old names are still extensively used, the latter are given as synonymes in a subordinate type and position; and those officinal titles which have been superseded by others adopted at the present revision, are inserted beneath, with a reference to the Pharmacopœia of 1860 [in the last edition].

"To one familiar with the British Pharmacopœias, it will be obvious that, in the preparation of our own, many of the processes have been taken from them with little alteration. This has been done advisedly."

It is of the highest importance that medicines having the same name should have the same composition; and as British works on medicine are much used in this country, it would lead to never-ending confusion if the substances they refer to by name should differ materially from those known by similar names with us. It has, therefore, been a general aim to bring our pharmacy into as near a correspondence as possible with that of Great Britain; but in all cases in which a greater purity or efficiency in the medicine,

or greater convenience and economy in the process, or any peculiarity in the relation of the preparation to our own circumstances and wants, called for deviation from the British standards, modified or wholly original processes have been adopted.

In the United States the Pharmacopœias used in addition to our own are the British, Prussian, and French. The last two are used principally in the shops of German *apothekes*, to which the numerous German citizens naturally resort, and in the French pharmacies, of which there is usually one or more in each large city.

At the date of the present revision of this work, the last edition of the British Pharmacopœia bears date 1867, of the Prussian (Pharmacopœia Borussica), 1862, of the French (the Codex), 1872, the latter being now under revision. The United States Pharmacopœia has just been issued for the sixth time. The convention which met in Washington in May, 1870, appointed a committee of revision, which, having met at intervals for nearly two years, and subjected the work of their predecessors and of the several colleges, which prepared preliminary reports, to a thorough revision, have issued the result in a volume of 383 pages, which is of authority for the next decade.

In the original and subsequent revisions of the present work, the object of supplying to physicians and pharmacists a more frequent and less restricted view of the progress of pharmacy, in connection with a practical treatise upon the science and art of pharmacy, has been attempted; in the present edition most of the working formulas of the Pharmacopœia of 1870 are introduced, together with a large number of unofficinal and extemporaneous formulas and prescriptions.

CHAPTER II.

ON WEIGHTS AND MEASURES AND SPECIFIC GRAVITY.

Metrology embraces the science of determining the bulk or extension of substances, called measurement, their gravitating force, called weight, and the relation of these to each other, called specific gravity.

In the present essay it is not designed to enter into the subject further than is necessary to the student of medicine and pharmacy.

Weights and Measures.—So difficult has it been found to modify or materially alter the systems of measurement and weight handed down from the earliest antiquity, and tenaciously adhered to by the mass of the people, and so inadequate have been the efforts of the British crown and Parliament to supply proper and invariable standards, that the present Troy and Avoirdupois

weights are believed to be even less perfect and consistent with each other than the very ancient standards from which they were derived. The inconveniences attendant on the use of separate sets of weights and measures for different kinds of commodities have probably always been felt, and are only partially remedied by adapting these to one common unit to which all can be reduced. This adaptation, in the case of our different standards, is through the grain or unit of weight; the systems of Troy, Apothecaries' and Avoirdupois weights, and of Wine measure, are all readily compared through this common standard—the *grain*.

Troy Weight is used by jewellers, and at the mints, in the exchange of the precious metals. Its denominations are the pound, ounce, pennyweight (= 24 grs.), and grain.

Apothecaries' Weight is used by apothecaries and physicians in mixing and prescribing medicines, and is officinal in the United States Pharmacopœia. The denominations of the apothecaries' weight are pounds, ounces, drachms or drams, scruples, and grains. Its pound, ounce, and grain correspond with the Troy weight.

Avoirdupois Weight is used in general commerce, and by apothecaries in their strictly commercial transactions, as in buying and selling medicines without the prescription of a physician, and also in compounding recipes for domestic purposes and for use in the arts. As at present used, it has pounds, ounces, and fractions of the ounce. Its higher denominations need not be named.

Decimal Weight, or *Metrical System*.—By the use of a decimal system in measuring, which corresponds with the system of notation universally in use, the calculations for reducing one denomination of the old systems into another are avoided, the decimal mark being all that it is necessary to adjust. So great is this merit that men of science the world over now generally adopt it, and although neither of the pharmacopœias in use in the United States uses it in their formulas, many regard its incorporation into pharmacy as only a question of time. It is quite necessary to the understanding of modern chemical works to be acquainted with this system.

The unit of length in the metric system is the *metre*, equal to 39.37 English inches; this is an arbitrary length, a standard metre having been prepared by authority of the French government, and preserved in Paris, from which all copies are made for use.

After earnest discussion in the Committee of final revision and publication, appointed by the decennial Pharmacopœial Convention of 1870, the use of apothecaries' ounce has been continued in the United States Pharmacopœia, and this vexed question is set at rest among us for another decade. This abandonment of the pound and the use of the new officinal word *troyounce* remove the uncertainty formerly pertaining to the weights directed in the officinal formulas, though the distinction between the officinal and

commercial weights needs to be kept in view in many pharmaceutical processes.

In the General Council of Medical Education and Registration, to which the Consolidated British Pharmacopœia was submitted for adoption, the modification of the previously existing weights, involving a change in the value of the grain, which had been adopted by the Pharmacopœia Committee, was considered, and received a most decided negative. The Council resolved, "That the weights used in the British Pharmacopœia be the imperial or avoirdupois pound, ounce, and grain; and that the terms 'drachm' and 'scruple,' as designating specific weight, be discontinued."

The British Pharmacopœia has furnished much material for the present edition of this work, and numerous formulas are inserted in which the avoirdupois or commercial weight is directed, and when this is intended care will be taken to indicate it in the text.

A knowledge of these standards and their relations to each other —always a most important preliminary item in the study of Pharmacy—is now rendered indispensable by the fact that the two Pharmacopœias used in this country and in Great Britain agree only in the unit of each system, *the grain*.

In the following tables I have endeavored to display, in the simplest and most comprehensive manner, the value of each denomination in the respective weights, and the relation of these to each other:—

Table of the U. S. P. Apothecaries' Weight.

20 grains = ℈j (one scruple)	= gr. xx.	
60 grains = ʒj (one drachm)	= ℈iij	(3 scruples).
480 grains = ℥j (one troyounce)	= ʒviij	(8 drachms).
5760 grains = ℔j (one pound)	= ℥xij	(12 troyounces).

Table of Avoirdupois Weights.

437.5 grains = 1 oz. (one ounce).
7000 grains = 1℔ (one pound, Com.) = 16 oz.

The *use of signs* is here seen to be of importance, as designating, when correctly used, to which system of weights the particular denomination refers; thus, ℥j means 480 grains; while *one oz.* means 437.5 grains. The sign for designating the pound is not so distinctive; ℔j is applied equally to the apothecaries' pound, 5760 grains, and to the avoirdupois pound, 7000 grains.

Comparison of the Apothecaries' and Avoirdupois Weights.

The *comparative value* of the different parallel denominations may be thus expressed:—

The *apothecaries' ounce* (troyounce) contains 42½ grains *more* than the commercial. The *pound* (℥xij) contains 1240 grains *less* than the commercial.

The apothecaries' pound contains ℥xij; the avoirdupois pound 16 oz.

480 grains, (℥j) × 12 = 5760 grains, ℔j, U. S. P.
437.5 " (1 oz.) × 16 = 7000 " 1 ℔, Commercial.

To the pharmacist who manipulates with large quantities of drugs, the use of apothecaries' weights is very inconvenient, and a convenient rule for converting one system into the other is a desideratum. The following is the simplest rule for the purpose with which I am acquainted, and gives the exact result.

To convert a given weight troy into avoirdupois, reduce it to ounces, add one-tenth, divide by sixteen, and deduct one and a quarter grain for every ounce in the original question; the answer will be in avoirdupois pounds, thus:—

124 + 12.4 = 136.4 ÷16 — 155 grs. = 8 ℔. 8 oz. 20 grs.

To convert avoirdupois weight to troy, reduce to ounces, and multiply the number of ounces by .912, and from the result deduct 4.16 grains for every pound in the original question; this gives the answer in troyounces:—

24 ozs. av. × .912—6.24 = ℥xxi. ℥vii.

United States Coins.

A convenient standard by which to test weights used in pharmacy is furnished by the legal coins issued from the mint of the United States. Those of gold are to be preferred, and when new will rarely be found to vary more than one-tenth of a grain from the following weights:—

Double Eagle,	$20 00,	weighs	516 grs.	Quarter Eagle,	$2 50,	weighs	64.5 grs.
Eagle,	10 00,	"	258 "	Three Dollar,	3 00,	"	77.4 "
Half Eagle,	5 00,	"	129 "	One Dollar,	1 00,	"	25.8 "

Weights.—The balance, or scale, is of course indispensable to the idea of metrology, and the possession of masses of previously ascertained gravitating force, called weights, is equally necessary. Scales are of various styles, although, for use in pharmacy, the kinds figured in a former chapter among the necessary implements

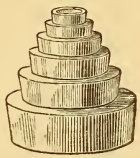
Fig. 90.

Series of apothecaries' or cup weights.

for furnishing the physician's office, answer every purpose. In this place, it will be proper to call attention especially to the usual *forms* of *weights* of the different systems. The apothecaries' weights are invariably, for all denominations, made of brass or copper. The

larger weights come in the *cup* form, as shown in Fig. 90. Each cup is equal to the sum of all those which fit in it, or is twice the sum of the next smaller. These weights are expensive, and, unfortunately, too little used by physicians, and even by some apothecaries. The small weights which accompany the box scales, and figured in a former chapter, are used for all denominations up to two drachms, and then the common commercial or avoirdupois weights, which are cheaper than the brass cup weights, are frequently brought into use.

Fig. 91.



Commercial or avoirdupois weights.

These are usually in *piles* of iron, brass, or zinc, of the form shown in the annexed figure, each weight being half that of the one below it. In a large number of processes, officinal in the U. S. Pharmacopœia, one ounce or two ounces are ordered, and in these cases, if the avoirdupois weight is used, a ℈ij or ʒj and ʒss weight must be added from the small set. In the case of a pound being ordered, as there shown, 13 ounces from the pile, and a ʒj from the small set, will nearly approximate the required weight.

The Decimal System.—The attention of pharmacists and of commercial men has recently been directed to the subject of reforming the systems of weight and measurement in use in this country and in England, and the most prominent change now proposed is the entire substitution of the French decimal system for all those now in use. This system is now used in most analytical laboratories in this country, and throughout Europe, and although its adoption for the purposes of trade is, as yet, considered rather chimerical, yet it is worthy of careful study, and as it is so useful to all who pursue chemistry and pharmacy, the following table is inserted.

Comparative Table of Decimal with Avoirdupois and Apothecaries' Weights.

Names.	Equivalent in Grammes.	Equivalent in Grains.	Equivalent in Avo'dup's Weight.			Equivalent in Apothe's Weight.			
			lb.	oz.	gr.	lb.	oz.	dr.	gr.
Milligramme . .	.001	.0154							
Centigramme . .	.01	.1543							
Decigramme . .	.1	1.5434							1.5
Gramme	1	15.4340							15.4
Decagramme . .	10	154.3402		$0\frac{1}{4}$	45			2	34.0
Hectogramme . .	100	1543.4023		$3\frac{1}{2}$	12.152		3	1	43.0
*Kilogramme . .	1000	15434.0234	2	$3\frac{1}{4}$	12.173	2	8	1	14
Myriagramme . .	10000	154340.2344	22	$0\frac{3}{4}$	12	26	9	4	20

The starting point of this system, the metre, was supposed to be the one ten-millionth part of the quadrature of the earth's circum-

* Abbreviated Kilo.

ference around the poles, and this was selected as being a natural and invariable standard from which to take a measure; the highest authorities have, however, shown this assumption of accuracy to be fallacious, and consequently not more worthy of regard than any other standard that might have been selected. The metre has been subdivided into decimetres, centimetres, and millimetres. A cubic decimetre is called a litre, and this is the unit of measures of capacity. It contains rather more than a quart. In order to obtain a unit of weight, a cubic centimetre of distilled water is weighed at the temperature of 4° Centigrade (39.2° F.), and is called a gramme. It is equal to 15.434 grains. The gramme is divided, as is shown in the table below, into tenths, hundredths, and thousandths, and multiplied in the same ratio, with names corresponding to the weights contained in the table.

The apothecaries' weight of other civilized countries is subdivided similarly to our own, though the value of the different denominations varies considerably, as will be seen from the annexed table.

In Portugal, Spain, and Italy, all the subdivisions of the pound correspond to ours, except the scruple, which contains 24 grains, thus making the pound 6912 grains, one-fifth more in number than the troy grains contained in a troy pound. The medicinal weight of France is the gramme, and for an account of the weight about to become the standard in the German Zollverein, we refer to a notice in the *Amer. Journ. of Pharm.*, 1859, p. 207. The Nuremberg weight is the legal standard in Denmark, Norway, Sweden, Russia, and in nearly all the German States, with the exception of Austria, Prussia, Saxony, and Bavaria; but its value varies in the different countries between 357.845 and 357.567 grammes, and is still less in Sweden. In the following table the pound is compared with grammes, and the different medicinal grains with the troy grain:—

1 ℔ German Zollverein	= 500. gram.	1 korn	= 0.259 Troy grs.	= .0166 gram.
" Austria	= 720.009 "	1 grain	= 1.127 "	= .0729 "
" Holland, Belgium, Switzerland	= 375.000 "	"	= 1.005 "	= .0651 "
" England and U. S.	= 373.246 "	"	= 1. "	= .0648 "
" Bavaria, Greece	= 360. "	"	= .965 "	= .0625 "
" Russia, Norway, Frankfort-on-the Main	= 357.845 "	"	= .959 "	= .0625 "
" Denmark, Holstein, Hessia, Wurtemberg	= 357.664 "	"	= .959 "	= .0621 "
" Hamburg	= 357.629 "	"	= .959 "	= .0621 "
" Baden, Hanover, Oldenburg	= 357.567 "	"	= .959 "	= .0621 "
" Berne	= 356.578 "	"	= .955 "	= .0679 "
" Sweden	= 356.227 "	"	= .954 "	= .0618 "
" Prussia, Saxony,	= 350.783 "	"	= .940 "	= .0609 "
" Rome	= 339.161 "	"	= .785 "	= .0491 "
" Spain	= 345.072 "	"	= .770 "	= .0499 "
" Portugal	= 344.190 "	"	= .769 "	= .0498 "

Measures of capacity are used for liquids, and, in the higher denominations, for corn and the cereal grains; but the only table of these we need at present is that employed in medicine, called Wine Measure. The unit of this system is called a *minim*, and is equal to about .95 of a grain of pure water at 60° F.

Table of the Wine Measure. U. S. P.

60 minims are one fluidrachm.
8 fluidrachms are one fluidounce.
16 fluidounces are one pint.
2 pints are one quart.
4 quarts are one gallon.

Or thus:—

Minims.			Grains of water.
60 = f℥j	(one fluidrachm)	= ♏ lx =	56.9
480 = f℥j	(one fluidounce)	= f℥viij =	455.7
7,680 = Oj	(one pint)	= f℥xvj =	7,291.2
61,440 = Cong. j	(one gallon)	= Oviij =	58,328.8

Besides the discrepancy occasioned by the minim not being equal to one grain of the natural liquid standard, it will be perceived at once that a wide variation exists in the denominations above an ounce. The fluidounce contains 480 minims, as the apothecaries' ounce contains that number of grains; but in the pint are 16 fluidounces, while the corresponding pound contains only 12 ounces. From these causes, the adjustment of proportions of solids to liquids, when accuracy is required, is a matter of no little calculation.

In England this system of measures has been revived of latter years, so as to bring about a close relation between the solid commercial ounce and the fluidounce. In the Imperial measure, the minim is equal to .91 of a grain, and it is multiplied as follows:—

Imperial Measure. Ph. Br.

Minims.			Grains of Water.
60 = f℥j	(one fluidrachm)	= ♏ lx =	54.6
480 = f℥j	(one fluidounce)	= f℥viij =	437.5
9,600 = Oj	(one pint)	= f℥xx =	8,750*
76,800 = Cong. j	(one gallon)	= Oviij =	70,000

The Imperial pint is, within an inconsiderable fraction, exactly one-fifth larger than the wine pint.

A wine pint	= 28.875	cubic inches,	or 7291.11 grains.
Add one-fifth,	= 5,775	" "	or 1458.22 "
	34.650	" "	8749.333 "
An Imperial pint	= 34.659	" "	8750

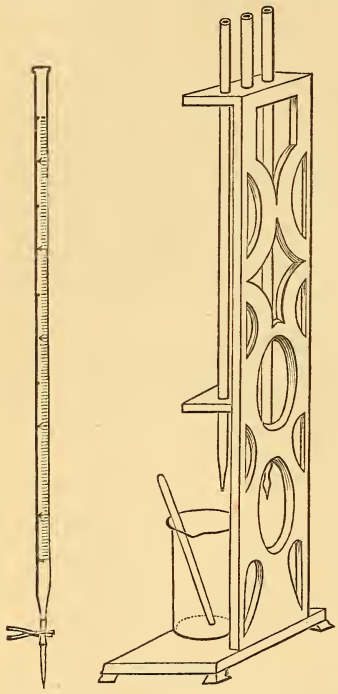
The same relation holds good in the case of the gallon.

* Equal to 1 lb. 4 oz. avoirdupois weight.

Metrical Measure of Capacity.—It may be appropriate to this place to describe the measure of capacity adopted in France, which is frequently referred to in scientific works, and has of late years been introduced in analytical chemistry, for the purpose of avoiding the weighing of precipitates, and to facilitate analyses in general. The cube of one decimetre, which equals 3.937 English inches, is called a litre, and measures 2.1135 pints. The weight of one cubic decimetre of water at 4° C. (39.2° F.) is one kilogramme. The one-thousandth part is a cubic centimetre, or one millilitre, and contains 1 gramme of distilled water. The close relation between the measures of length, of capacity, and of gravity, renders it more easy to measure correctly than to weigh accurately.

By calculation from the above, we shall find that one fluidounce of our officinal measure equals in capacity 29.53 cubic centimetres, and we have thereby a convenient means of ascertaining the correctness of graduated measures without the necessity of weighing water at a certain temperature on a delicate balance. All the subdivisions and the higher denominations may be easily calculated, and all that is necessary is to measure the corresponding number of cubic centimetres of any liquid into the graduate in order to ascertain its correctness.

Fig. 92. Fig. 93.



Burette. Burette stand.

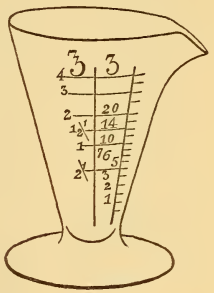
Glass tubes, which are graduated into the subdivisions of cubic centimetres—*burettes*, as they are called, shown in Fig. 92—are now extensively manufactured and sold by dealers in chemical apparatus. It must be remembered that all these instruments should be carefully tested before reliance is placed upon them, although they are generally correct.

Since the introduction of volumetric solutions for analysis into the British Pharmacopœia, the use of burettes has greatly increased, and a useful stand has been devised by Dr. Squibb for the purpose of supporting them. See papers in 21st volume of *Proceedings of the American Pharmaceutical Association.* Fig. 93 shows the arrangement of the stand when ready for use; the burettes are prevented from slipping through the holes by sections of gum-elastic tubing being stretched around them.

Graduated measures of glass of Oj, f℥viij, f℥vj, f℥iv, f℥ij, f℥j, f℥j capacity are manufactured, and sold by druggists; these are sometimes quite inaccurate, but may be readily verified, as above, by

balancing them on the scales, and gradually adding pure water until the required weight in grains, as shown in the tables, is attained. In the same way we may graduate measures, marking the denominations by the following ready process:—

Fig. 94.



f℥iv graduated measure.

Having thinly coated one side of the glass with wax, balance it on the scales, adjust the weights, and add the required number of grains of pure water, observing to add it drop by drop toward the last; as soon as the weight is accurately counterpoised, remove the measure to a level table or counter, so high that it will be on a line with the eye, and carefully, with the point of a pin, mark the line formed by the surface of the liquid, and opposite this the appropriate sign; this may be rendered more clear and distinct afterwards. In the same way mark the various other denominations, having regard to the temperature, which should not vary far from 60°. Now form a paste, by mixing a sufficient quantity of finely-powdered fluor-spar with sulphuric acid, and spread this over the marked surfaces, and set the measure aside for a day or two, after which wash it off and remove the wax; the graduated measure is now indelibly and distinctly marked, and, if we have used the proper care, more accurately than is usual with those sold. I have compared two, in which the one fluidrachm mark of one corresponded nearly with the two fluidrachm mark of the other, and in other respects they were almost as much at variance.

Fig. 95 exhibits a graduated measure, patented by W. Hodgson, Jr., of Philadelphia; it is made in a mould in which depressions are cut for the several denominations of the scale, and, on the reverse, for the corresponding approximate measurements used in popular and domestic practice. By a plunger, which is graduated precisely to the required bulk and thrust into the mould while the glass is fluid, the required measurement is accurately adjusted to each of these marks, and the necessity of further graduation is obviated.

Fig. 95.

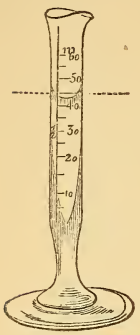
Hodgson's graduated measure.

These measures are much more accurate than the ordinary kinds met with in the shops, though the glass is rather deficient in that perfect surface which characterizes blown-glass vessels. The smaller sizes are perfectly adapted to medicine chests and saddle-bags, and are much more satisfactory in measuring fluidrachms than the common kinds.

A precaution to be observed, whether in graduating or using a measure, particularly of small diameter, may be appropriately mentioned here.

Owing to the adhesion of the liquid to the sides of the measure, its surface is concave, and shows, from a side view, two lines; one

Fig. 96.



Minim measure.

where the edge of the liquid adheres to the glass, and the other, the line of the lower surface of the concavity. In order to fix the true line in this case, it must be intermediate between the upper and lower edge of the liquid, and not at either surface. This is more obvious the smaller the diameter of the measure, and, in the accompanying drawing, the dotted line has been made at the proper point for measurement. This concavity is readily corrected by a drop of alcoholic solution of corrosive sublimate, when the true line is at once seen.

Besides the common forms of glass graduated measures, a measure is used, especially by German pharmacists, made of block tin and graduated on the inside; each denomination is marked by a raised rim, and the quantity designated by an appropriate sign. This is especially convenient for measuring hot liquids, and if readily procurable, would soon be generally introduced.

Approximate Measurement.—The approximate standards of measurement are very inaccurate, but they have no wider range than the doses of medicines, so that they are for the most part satisfactory. The following table exhibits those in common use:—

A gill mug or teacupful	f℥iv.
A wineglassful	f℥ij.
A tablespoonful	f℥ss.
A dessertspoonful	f℥ij.
A teaspoonful	f℥j.
A drop	from ⅓ to 1½ minim.

Of the above, it may be remarked that the wineglassful is frequently less than two fluidounces, although the champagne glass is nearer four fluidounces. I have observed that the modern teaspoons are larger than formerly, and that the silver spoons are generally larger than those of common metal of the same nominal size.

The size of drops varies from various causes, of which the nature of the liquid, the size and shape of the lip of the vessel from which dropped, the extent to which the lip is moistened, and the rapidity of dropping are the most important.

Four lists are appended: 1st. That by Elias Durand, originally published in the *Journal of the Philadelphia College of Pharmacy*, vol. i. p. 169, and copied into most of our standard works; from this I have omitted several items, on account of their standard strength having been altered since the period of his experiments. 2d. That of Prof. Procter, published in the tenth edition of the *United States Dispensatory*, and confined to different essential oils. The 3d and 4th lists I have prepared as the result of my own observations, chiefly confined to medicines not included in the foregoing.

A Table of the number of drops of different liquids equivalent to a fluidrachm U. S. P., as observed by Durand and by Procter—A, *from the bottles from which they are commonly dispensed*, B, *from a minim measure; and Parrish*, A (*at* 80° F.), *from pint or half pint tincture bottles, and* B, *from a minim measure.*

Name of Substance.	Durand.	Procter.		Parrish.	
		A.	B.	A.	B.
Acetum opii	...	...	...	90	69
Acidum acet. cryst.	120	...	...	...	...
Acidum acet. commercial	...	...	...	73	102
Acidum acet. dilut.	...	...	...	55	52.5
Acidum hydrocyanic.	45	...	...	53*	52
Acidum muriatic.	54	...	...	...	...
Acidum nitric.	84	...	...	...	...
Acidum nitric. dilut.	...	...	...	62	44
Acidum sulphuric.	90	...	...	...	...
Acidum sulph. aromat.	120	...	...	116	148
Acidum dilut.	...	...	...	54	49
Alcohol	138	...	...	118	143
Alcohol, diluted	120	...	...	98	124.5
Aqua	45	...	...	64.5	46
Aqua ammoniæ	54	...	...	49	62
Creasote	...	91	95	...	...
Chloroform	...	...	...	180	276.5
Ether	150	...	...	...	...
Ext. valerian, fld.	...	...	...	115	126
Glycerine	...	...	...	53	135
Glycerine, average	...	...	...	55	84.7
Infusion digitalis	...	...	...	62.5	60
Liquor iodini comp.	...	...	...	75	75
Liquor hydrarg. et arsen. iod.	...	...	...	52	52
Liquor potassæ arsenitis	...	...	...	60	63
Oil of almonds (sweet)	120	...	...	...	...
Oil of aniseed	120	85	86	...	...
Oil of caraway	...	106	108	...	...
Oil of cloves	120	103	103	...	...
Oil of chenopodium	...	97	100	...	...
Oil of cinnamon	120	100	102	...	...
Oil of croton tiglium	...	...	...	80	92
Oil of cubebs	...	86	96	...	...
Oil of fennel	...	103	103	...	...
Oil of gaultheria	...	102	101	...	...
Oil of hedeoma	...	91	91	...	...
Oil of peppermint	120	103	109	...	...
Oil of mint	...	89	94	...	...
Oil of olives	120	...	...	76	99
Oil of rosemary	...	104	105	...	...
Oil of savine	...	102	108	...	...
Oil of sassafras	...	102	100	...	...
Oil of tansy	...	92	111	...	...
Oil of valerian	...	116	110	...	...
Spirits of nitrous ether	...	...	...	90	148
Spirits of ether, comp.	...	...	...	90	140
Syrup of gum Arabic	...	...	...	58	56
Syrup of squills	...	...	...	85	88
Tincture of assafœtida	120	...	...	...	...
Tincture of aconite root	...	...	...	118	130

* From f℥j Tr. bot. 53.

Name of Substance.	Durand.	Procter.		Parrish.	
		A.	B.	A.	B.
Tincture of chloride of iron	132	...	...	106	151
Tincture of digitalis	120	...	...	...	...
Tincture of guaiacum	120	...	...	...	...
Tincture of iodine	...	...	113	144	...
Tincture of opium	120	...	106	147	...
Tincture of opium and camphor	...	...	95	110	...
Tincture of tolu	...	...	120	138	...
Vinegar, distilled	78	...	...	...	...
Vinegar of colchicum	78	...	...	...	...
Vinegar of squills	78	...	...	...	...
Wine, Teneriffe	78	...	...	...	...
Wine, antimonial	72	...	62	87	...
Wine, colchicum	75	...	...	...	...
Wine, opium	78	...	78	92	...

The number of Drops of Water equivalent to f℥j *dropped from* f℥j *vials.*

1st trial 34.	2d trial 48.	3d trial 32.	4th trial 48.
5th trial 60.	6th trial 50.	7th trial 65.	Average 48.1.

It will be observed from the above tables that the *size* of the drops of different liquids bears no relation to their *density;* sulphuric acid, sp. gr. 1.84, is stated in Durand's table as yielding 90 drops to the fluidrachm, while water yields but 45, and oil of anise, sp. gr. 97, according to Prof. Procter, 85. It follows then that the weight of drops varies for most liquids.

Specific Gravity.—As this text-book is designed to direct the practitioner of medicine and pharmacy in the necessary pursuits of his office or shop, I shall confine this essay to the specific gravity of solids and liquids, the most important branches of the general subject to this class of readers.

It was said, at the commencement of this chapter, that while extension, and gravitation or weight, are each capable of a separate standard of measurement, it is impossible to bring them to a common standard; they are only capable of being *compared* with each other.

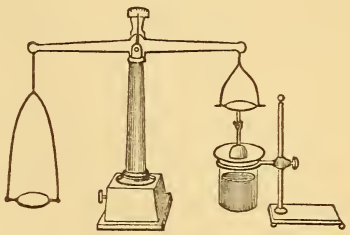
The importance of understanding this branch of physics is now so universally acknowledged, that no argument will be presented to enforce its thorough study. It is well defined to be the relative weights of equal bulks of different bodies compared to some standard. In the case of solids and liquids not aeriform, the adopted standard is distilled water at 60° F., and barometric pressure 30 inches. As distilled water at 60° F., 30 inches barometric pressure, has been adopted as the standard for solids and liquids not aeriform, it follows, that it is only necessary to ascertain the weight of a bulk of water equal to the bulk of any given substance to ascertain the sp. gr. of that substance by the rule of proportion.

The method of finding out the weight of a bulk of water equal to any substance which is insoluble in it is, after having ascertained its weight in air, to immerse it in water, and note the loss of weight

sustained by this experiment. This follows from the law of Archimedes, "that bodies immersed in any liquid are buoyed up with a force equal to the weight of the liquid displaced." The arrangement of apparatus by which this is most easily accomplished is shown in Fig. 97.

A scale beam has one short stirrup to support a dish with a hook fastened to its under side, to which the substance to be examined is hung by a fine wire; a beaker glass containing distilled water is placed in the ring of a retort-stand, and after the substance has been weighed in the air, the glass is raised until the substance is entirely submerged, the loss is then noted, and is the weight of the water displaced. Should it happen, however, that the body is soluble in water, some other liquid must be used, the sp. gr. of which is already known. The following formula for ascertaining the sp. gr. of bodies is applicable to all cases, namely:—

Fig. 97.



Hydrostatic balance.

1st term: The weight of the liquid displaced.
2d term: Weight of the substance in air.
3d term: The sp. gr. of the liquid used.

For example, a piece of lead weighs 1133 grains; when weighed in water, it loses 100 grains. Divide the original weight by the loss in water (namely, 100 grains), and we find the sp. gr. 11.33.

It sometimes occurs that we wish to ascertain the sp. gr. of a body soluble in water. To do this we employ some other liquid in which it is insoluble, the sp. gr. of which we have already ascertained; having learned the weight of the substance in air, we then weigh it in the liquid chosen.

For example, a lump of alum, weighing in the air 10,000 grains, when immersed in oil of turpentine loses 5363 grains; the sp. gr. of the oil of turpentine being .880, then—

5363 : 10,000 : : .880 : 1.64.

To ascertain the sp. gr. of a body lighter than water, it is necessary to immerse it, by attaching some heavy substance which has previously been brought to a state of equilibrium when immersed: thus, a brass globe weighing 555 grains in the air requires, when immersed in water and attached to a counterpoise, which has been brought to a state of equilibrium after immersion, 1037 grains to restore the equilibrium; this shows the amount of water displaced by the globe, and by the rule given we find—

1037 : 555 : : 1 : .5351 sp. gr.

Should we desire to ascertain the sp. gr. of a substance which is in small particles or fine powder, we first learn its weight in air,

and then introduce it into a sp. gr. bottle, which holds 1000 grains of distilled water. We now fill the bottle with water, and note its entire weight. From this we deduct the original weight of the powder, and we have thus learned the weight of the water in the bottle; the difference between this and the 1000 grains, the capacity of the bottle, gives the weight of the bulk of water equal to that of the powder. Thus, 250 grains of powder, introduced into the bottle and the bottle filled with water, weighed 1209.75 grains, from which we deduct the weight of the powder, 250 grains, which leaves 959.75; this subtracted from 1000 leaves 40.25, the weight of water equal to the bulk of the powder used; then—

40.25 : 250 : : 1 : 6.21 sp. gr. of the powder.

If we take a vial which will hold an ounce of water by weight, we find it will hold about an ounce and a half of nitric acid, and about three-quarters of an ounce of ether; hence we may say, approximately, that nitric acid is twice as heavy as ether, or that it is half as heavy again as water, while ether is only three-quarters as heavy. We thus compare these two liquids with a common standard, and one which, being universally diffused in a state of tolerable purity, furnishes the most ready means of comparing solid or liquid substances together. The relation which the weight of a substance bears to that of water is, therefore, called its specific gravity. Water being assumed as 1 in the illustration just given, nitric acid would be $1\frac{1}{2}$ or 1.5, and ether $\frac{3}{4}$ or .75. Upon this principle we may ascertain the specific gravity of all liquids by having a bottle, the capacity of which is well and accurately determined, filling it with these various liquids at a certain normal temperature, ascertaining their weight, and by a simple calculation bringing them to this common standard. The specific gravity of substances, when accurately ascertained, constitutes one of their most important characteristics. In pharmacy, it is much employed to indicate the strength and purity of medicines, particularly acids, alcohol, the ethers, and essential oils; and a physician is deficient in one of the most important aids to diagnosis who has not at hand the means of taking the specific gravity of *urine*.

The apparatus for ascertaining the specific gravity of liquids is of two kinds: first, specific gravity bottles; and second, hydrometers, or loaded tubes which mark the density of liquids by the depth to which they sink in them, according to known and purely artificial standards. The most convenient specific gravity bottles are graduated to hold 1000 grains, or 100 grains of pure water at 60° F. Those made by Dr. W. H. Pile, of Philadelphia, are accurate and reliable; they are of two kinds, stoppered and unstoppered. The former are most approved; they are accompanied by a little counterpoise to be placed on the opposite scale plate, which exactly balances the empty bottle, so that the weights which balance it, when filled and placed on the scale, indicate the weight of its contents.

In filling the stoppered thousand grain bottle, it requires to be

filled a little above the point in the neck to which the stopper will reach when replaced, so that this shall force out the air and a small portion of the liquid into the capillary tube drilled through it. The whole bottle is then wiped clean and dry, and weighed.

Fig. 98.

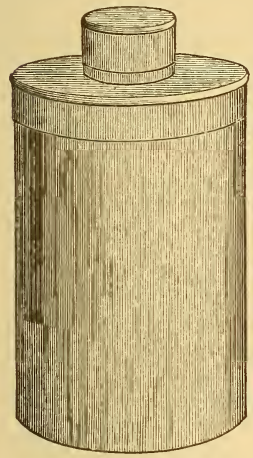
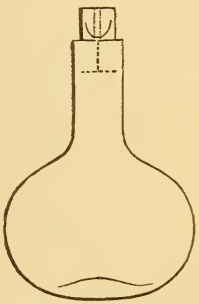


Fig. 100.

Fig. 99.



Stoppered specific gravity bottle, tin-box, and counterpoise.

The unstoppered thousand grain bottle is marked by the scratch of a file opposite the point in the neck to which the liquid must reach; this line should be intermediate between the upper and lower edge of the concave surface of the liquid in the neck when filled. The hundred grain bottles are of the same description, and are used in the same way; they are convenient when only very small quantities can be obtained for testing, but are, of course, not quite so accurate.

Fig. 101.

Specific gravity bottle, unstoppered.

One particular merit of the 1000 and 100 grain bottles is, that the weight of a liquid, as obtained by filling and weighing them, expresses its specific gravity. The equation is this: as the weight of a certain bulk of water is to the weight of the same bulk of the liquid being tested, so is the specific gravity of water, which is unity, to the specific gravity of the liquid; or as 1000 is to the weight of the liquid, so is 1 to the specific gravity of the liquid. Having obtained the weight of this quantity of a liquid, we have its specific gravity, attention being required to the decimal mark merely.

If, for instance, we fill the 1000 grain bottle with alcohol, and find it weighs 835 grains, we write its specific gravity .835, placing the decimal mark before the figures, because the weight is less than the unit adopted. If we fill it with chloroform, and find the weight to be 1490 grains, we state the specific gravity at 1.490, placing the

decimal after the first figure; or, if we find it to hold 13,500 grains of mercury, we state the specific gravity 13.5, the decimal being varied for obvious reasons; but no calculation is necessary to ascertain their relation to water.

The specific gravity bottle I next proceed to describe does not exhibit the specific gravity of the liquid without a calculation, special in each case, but possesses the advantage of being cheap and extemporaneous, and, if carefully made, is nearly as accurate.

Select a smooth and clean bottle, not too thick, with a ground glass stopper; after first filing down the side of the stopper a small groove to subserve the purpose of the capillary orifice in the stopper of the 1000 grain bottle, adjust it to one or more weights which counterpoise it, and put these aside for that use. Now find, by several trials, the exact weight of water it will hold at the proper temperature, and mark this on the bottle, or on a paper in which it is constantly wrapped; this is used in the same way as the 1000 or 100 grain bottle, except that it is necessary to make a calculation, after each weighing, to ascertain the specific gravity of the liquid. Suppose it to be a f℥ss bottle, and to contain, say 242.5 grains of pure water, and the liquids tested to have weighed 256 grains; now, to ascertain its specific gravity, a sum must be made as above stated: as the weight of a certain bulk of water is to the weight of the same bulk of this liquid, so is the specific gravity of water to the specific gravity of this liquid:—

242.5 : 256 : : 1 : 1.055; or divide the weight of the liquid by the weight of the same bulk of water, thus $\frac{256}{242.5} = 1.055$, the sp. gr.

I have, though rarely, been able to select f℥ss bottles, which, by modifying their size by filing the stopper, would hold exactly 250 grains, or $\frac{1000}{4}$; hence it was only necessary to multiply the ascertained weight by 4 to get the specific gravity. This plan of taking the specific gravity is so much more accurate than that by hydrometers, that these extemporaneous or home-made bottles, when well made, and used with good scales, are to be preferred to the best hydrometers, which rarely mark with precision more than the second decimal, a point reached without difficulty with a bottle, even when the scales do not indicate the fractions of a grain. Unstoppered specific gravity bottles are still more readily made.

Sometimes the quantity of liquid is but a drop or two, and recourse is had to the expedient of throwing it into some liquid in which it is insoluble, and bringing the sp. gr. of the latter to that of the drop so added, which is known by the drop floating at any point in the liquid equally well; the sp. gr. of the liquid is then ascertained by weighing it in the sp. gr. bottle.

This last method of finding the sp. gr. is the same in principle as that afforded by Lovi's beads, small glass balls of different weights and bulks so graduated that they will float at any point in the liquid in which they are placed; this sp. gr. having been ascer-

tained, the bead is so marked, and then becomes an instrument useful for ascertaining that particular density.

An instrument has been employed which has one advantage over the sp. gr. bottle, in that it is much more easily cleaned when soiled by viscid and tenacious matters. It consists of a piece of glass tube, shown in Fig. 102, partly filled with mercury so that it will readily sink in liquids, then hermetically sealed, and the end drawn out into a hook or eye so that it can be readily attached to a scale beam; it is then counterpoised and weighed in distilled water at the temperature of 60° F., and the weight of water it displaces is noted for future experiments; if when immersed in a liquid it displaces 900 grains, and it displaced 1000 in water, we know the sp. gr. to be .900, because 1000 : 900 : : 1 : .900.

Fig. 102.

Loaded glass cylinder.

The greatest practical difficulty in accurately adjusting a specific gravity bottle, and in taking the specific gravity of liquids, has relation to the temperature. The proper temperature for liquids to be measured by the specific gravity bottle is 60° Fahrenheit's scale, which at certain seasons of the year, in our climate, is readily attainable, but in hot weather the temperature of water will reach 90° or more; the dew-point then rises above 60°, so that if the water be brought to that temperature artificially and put into the bottle, the moisture deposited upon the outside of the bottle while weighing it will sensibly increase its weight. In order to obviate this difficulty, it is more convenient to have tables giving the variations of specific gravity by elevation or depression of temperature. The tables of this description formerly in use are unsatisfactory and conflicting, and have led Dr. Pile to prepare an original table, founded upon many hundred trials at all temperatures from 50° to 93°. This he has kindly furnished me for publication. The utility of this table in verifying the accuracy of the specific gravity bottle at any temperature will be apparent.

It may be remarked that the glass bottle itself expands and contracts, and experiment has shown it will contain about .013 grain more for every degree above 60°, and as much less below it. In weighing liquids above or below that temperature, we do not obtain directly the true specific gravity, but the conjoined result of the expansion or contraction of the water and the glass bottle. If the actual specific gravity is sought, it will be necessary to make the proper corrections both for the liquid on trial and for the glass bottle. This also has been done in the following table.*

* For tables showing the variation in specific gravity of alcohol by changes of temperature, see Booth's "Encyclopædia of Chemistry," art. Alcoholometry, Tables III. and IV.

Table of Apparent Specific Gravity of Water as observed in a Glass Bottle at different Temperatures; also its true Specific Gravity. By W. H. PILE, M.D.

Temp. Fahr.	Sp. Gr. in Glass Bottles.	True Sp. Gr.	Temp. Fahr.	Sp. Gr. in Glass Bottles.	True Sp. Gr.
50°	1000.54	1000.67	72°	998.94	998.78
51	1000.50	1000.62	73	998.83	998.66
52	1000.46	1000.56	74	998.72	998.53
53	1000.41	1000.50	75	998.60	998.40
54	1000.36	1000.44	76	998.48	998.27
55	1000.30	1000.37	77	998.35	998.13
56	1000.25	1000.30	78	998.22	997.99
57	1000.20	1000.23	79	998.08	997.84
58	1000.14	1000.16	80	997.94	997.68
59	1000.07	1000.08	81	997.79	997.52
60	1000.00	1000.00	82	997.64	997.36
61	999.92	999.91	83	997.49	997.20
62	999.84	999.82	84	997.35	997.04
63	999.72	999.72	85	997.20	996.87
64	999.68	999.63	86	996.94	996.60
65	999.60	999.53	87	996.78	996.43
66	999.51	999.43	88	996.62	996.26
67	999.42	999.33	89	996.46	996.08
68	999.33	999.23	90	996.29	995.90
69	999.24	999.12	91	996.12	995.72
70	999.14	999.01	92	995.96	995.54
71	999.04	998.90	93	995.79	995.36

Schiff has proposed a very simple arrangement for the determination of the specific gravity of solid and liquid bodies. It consists merely of a test glass of even width graduated into cubic centimetres from the bottom and resting in a wooden or cork foot. It is used by pouring a convenient quantity of any liquid into the tube, noting its height, and weighing the apparatus in grammes; the solid body is then introduced in a coarse powder, the apparatus weighed again, and the height of the liquid noted. The difference of weight indicates the weight of the body, the difference of measure gives in cubic centimetres the amount of liquid displaced, and (as one cubic centimetre of water weighs one gramme) also the weight of distilled water in grammes displaced by the above body; consequently the weight of the body divided by the difference of measure in cubic centimetres gives the specific gravity.

To find the specific gravity of any given liquid, this is introduced into the tube previously weighed, the difference of weight in grammes after and before filling it is simply divided by the number of cubic centimetres occupied by the liquid, to furnish the specific gravity.

The greatest density of water is at 39° F., and as the specific gravity is usually taken at 60° F., there is a slight discrepancy in the weight of water, which is exactly one gramme for each cubic centimetre at 39°; but the expansion of water between 32° and 212° is not more than .012, and the difference of its weight at 39° and 60° so slight that for ordinary purposes it may be overlooked.

Hydrometers.—The specific gravity of liquids may be most readily ascertained by plunging in them instruments so adjusted as to mark their density by the depth to which they sink. These are called hydrometers, and although not capable of the same accuracy as specific gravity bottles, they furnish approximate results with great facility.

The application of the hydrometer depends upon the well-ascertained law that a body floating in a liquid displaces its own weight of the same, and its use dates back to the discovery of that principle, a period of about three hundred years before the Christian era.

Hydrometers are named with reference to the class of liquids for which they are designed, and to the scale upon which graduated. The kinds most sold are called Baumé's hydrometers or areometers; they are also called saccharometers, when adapted to the measurement of syrups; acidometers to acids; elæometers for oils, and urinometers for urine.

Cartier's hydrometer, which is somewhat used in France, is only applicable for light liquids; it is a modification of Baumé's Pése Esprit, and, having some points in the scale which correspond, is generally confounded with it.

Without intending to confuse the student with unnecessary details, I shall give in a few words the method of obtaining the standards on the respective scales, and the mode of converting them into specific gravity and the reverse rule, omitting the tables, which will be found in the *U. S. Dispensatory* and in chemical works.

Baumé had two instruments, one for liquids heavier than water, and one for liquids lighter than water; the former called *Pése Acide*, or *Pése Sirop*, and the latter *Pése Esprit*.

The zero for heavy liquids was water, and the point to which the instrument would sink in a solution containing fifteen per cent. of salt was marked 15°. The interval doubled gave 30°, the next 45°, and so on. The zero for lighter liquids, or *pése esprit*, was obtained by immersing the tube in water containing 10 per cent. of salt in solution, and the point to which it would sink in pure water he made 10°; dividing the stem into like intervals, he obtained 20°, 30°, etc., the intermediate degrees by subdivision.

Now it will be at once perceived that the slightest error made in obtaining the first interval by this process becomes increased in every extension, so that with all care and precaution to insure accuracy, scarcely any two instruments could be made to correspond precisely.

This mode of graduating hydrometers has long since been superseded by the equally practicable and more accurate method of obtaining the specific gravity of two known liquids at a certain fixed temperature. These are placed at the extremes of the scale, and the intermediate space is accurately subdivided into the requisite number of degrees.

The liquids ordinarily used for this purpose are, for liquids heavier than water, sulphuric acid and water; for those lighter than water, ether (highly rectified) and water—the specific gravity of these

being of course ascertained before each trial by a standard hydrometer, or by the use of the 1000-grain bottle: but authorities are not agreed precisely in fixing their specific gravities, so that even the most accurate manipulators are liable to error from this fact, unless by having a common definite rule accuracy is obtained. Another difficulty in regard to Baumé's hydrometers, as usually imported, is, that they are marked by arbitrary numbers, which have no necessary connection with the specific gravity, and they can only be used with facility when access can be had to the tables published in chemical works, in which the degrees of Baumé, with their corresponding specific gravity numbers, are represented.

The following simple formula has been contrived for the purpose of finding the specific gravity of any liquid, the degree of Baumé being known, or the reverse.

For Liquids heavier than Water.

1. To reduce Baumé to specific gravity. Subtract the degree of Baumé from 145, and divide into 145; the quotient is the specific gravity.

2. To reduce specific gravity into Baumé. Divide the specific gravity into 145, and subtract from 145; the remainder is the degree of Baumé.

For Liquids lighter than Water.

1. To reduce Baumé to specific gravity. Add the number of the degree to 130, and divide it into 140; the quotient is the specific gravity.

2. To reduce specific gravity to Baumé. Divide the specific gravity into 140, and subtract 130 from the quotient; the remainder will be the degree of Baumé. In this manner, the tables at the end of this article were calculated.

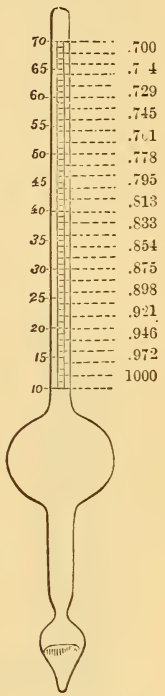
The *rationale* of this formula is more difficult to understand than its application. The modulus or constant number here used is the proportion which the space of one degree (or the bulk which one degree occupies) bears to the space or bulk of the whole hydrometer below the water line.

Or, it may be stated to be the proportion which the weight of water displaced by the hydrometer when floating in water, bears to the weight of water equal in bulk to one degree.

For example: suppose the weight of a hydrometer to be 200 grains, it is floated in water and marks the water line (10° B. in *pése esprit*, or 0° B. in *pése acide*); now to sink it one degree in the first case, $\frac{1}{140}$ of its weight must be added, or 1.428 grain; 140 is therefore the modulus of the scale for light liquids; in the other case, we must withdraw $\frac{1}{145}$ of its weight, or 1.38 grain, to enable the hydrometer to rise one degree; 145 is therefore the modulus of the *pése acide:* from this it will appear that the modulus determines the size of the degrees. That here presented was

selected (as most consistent with the practice of manufacturing chemists, and according with the tables published in the *United States Dispensatory*) by Henry Pemberton, Practical Chemist, of this city, to whose able article, showing the inconsistency of the standards in use, published in the *American Journal of Pharmacy*, vol. xxiv. p. 1, the reader is referred.

Fig. 103.



Hydrometer for liquids lighter than water.

The inconvenience of an arbitrary scale, as that of Baumé, has long been felt, and has led to the manufacture of the new style of hydrometer which is here figured; these have the scale of Baumé, with the actual specific gravity corresponding to it, written opposite each other on the tube.

This article, as manufactured by Dr. W. H. Pile, before referred to, is unexceptionable. He makes a large size containing two in a series, one for liquids heavier, and the other for liquids lighter, than water, each having an extensive range; and also a small size, consisting of two for light and three for heavy liquids. The advantage of the series of five small instruments is, that the scales, having a much less range, are capable of exhibiting more accurately slight differences in sp. gr. than in the other case. In the drawing, one of the large instruments is exhibited, considerably reduced in size; and, as the scales with the two sets of figures could not be represented in a single view of the tube, the printer has appended on either side the figures representing the degree of Baumé, and a part of those representing the sp. gr.

Besides these hydrometers, Dr. Pile makes others for special applications, and graduated to suit particular objects; one of the most curious of these is the Lactometer, for the measurement of milk, which, as we get it in large cities, is liable to adulteration, and especially to dilution with water. (*See* Lac Vaccinum, Part IV.)

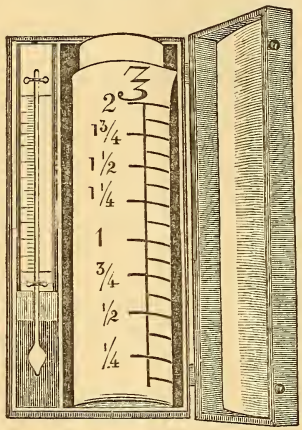
Of all the practical applications of the art of determining specific gravity, none is more important and interesting to the physician than its use in ascertaining the qualities of urine. The urinometer is the most delicate of this class of instruments; it is a hydrometer tube with a very small range, only going from 1.000 to 1.060 specific gravity; within these limits, all the variations of urine from its normal standard may be ascertained. So delicate are these determinations, that the variations of temperature, important in all cases, here require special attention; and accordingly many of the urinometers are accompanied by a little thermometer to be plunged into the urine simultaneously with the tube; sometimes the thermometer is inclosed in the tube, and at others, as in the apparatus

Fig. 104, accompanies it in a neat box containing also a graduated glass for containing the urine.

The thousand grain bottle, with proper observance of the thermometer, is, however, in this as in all other cases, the surest test of specific gravity.

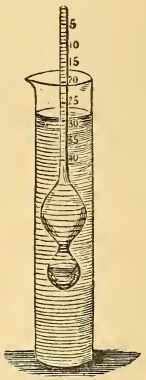
Fig. 105 represents the urinometer removed from the box and floated in the vessel accompanying it (in which the graduation marks are not seen). The graduation of the urinometer is such, that each degree represents 1-1000, thus giving the actual specific gravity by simply adding the number of degrees on the scale corresponding with the surface of the liquid to 1000. Thus, supposing the number cut by the surface of the fluid to be 30, as

Fig. 104.



Urinometer-box containing thermometer, graduated glass vessel, etc.

Fig. 105.



Urinometer in use.

Fig. 106.

Saccharometer.

shown in the figure, the specific gravity would then be 1.030. The average density of healthy urine is about from 10° to 25° of this scale, at 60° F., or sp. gr. 1.010 to 1.025. That of diabetic urine ranges from 30° to 60°, or sp. gr. 1.030 to 1.060.

Some hydrometers for liquids heavier than water are manufactured of small size, for the special purpose of measuring the strength of syrups. Fig. 106 represents one of these, which is graduated to Baumé's scale. It floats at 30° in a solution of the sp. gr. 1.26, the density of saturated simple syrup when boiling.

BAUMÉ'S DEGREES, WITH THEIR CORRESPONDING SPECIFIC GRAVITY.

Table for Liquids lighter than Water. Temp. 60° Fahr.

Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.
10	1.000	31	0.870	51	0.773
11	0.993	32	0.864	52	0.769
12	0.986	33	0.859	53	0.765
13	0.979	34	0.854	54	0.761
14	0.972	35	0.848	55	0.757
15	0.966	36	0.843	56	0.753
16	0.959	37	0.838	57	0.749
17	0.952	38	0.833	58	0.745
18	0.946	39	0.828	59	0.741
19	0.940	40	0.824	60	0.737
20	0.933	41	0.819	61	0.733
21	0.927	42	0.814	62	0.729
22	0.921	43	0.809	63	0.725
23	0.915	44	0.805	64	0.722
24	0.909	45	0.800	65	0.718
25	0.903	46	0.795	66	0.714
26	0.897	47	0.791	67	0.711
27	0.892	48	0.787	68	0.707
28	0.886	49	0.782	69	0.704
29	0.881	50	0.778	70	0.700
30	0.875				

Table for Liquids heavier than Water. Temp. 60° Fahr.

Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.	Degrees of Hydrom.	Specific Gravity.
1	1.007	26	1.218	51	1.543
2	1.014	27	1.229	52	1.559
3	1.021	28	1.239	53	1.576
4	1.028	29	1.250	54	1.593
5	1.036	30	1.261	55	1.611
6	1.043	31	1.272	56	1.629
7	1.051	32	1.283	57	1.648
8	1.058	33	1.295	58	1.667
9	1.066	34	1.306	59	1.686
10	1.074	35	1.318	60	1.706
11	1.082	36	1.330	61	1.726
12	1.090	37	1.343	62	1.747
13	1.098	38	1.355	63	1.768
14	1.107	39	1.368	64	1.790
15	1.115	40	1.381	65	1.813
16	1.124	41	1.394	66	1.835
17	1.133	42	1.408	67	1.859
18	1.142	43	1.422	68	1.883
19	1.151	44	1.436	69	1.908
20	1.160	45	1.450	70	1.933
21	1.169	46	1.465	71	1.959
22	1.179	47	1.480	72	1.986
23	1.188	48	1.495	73	2.014
24	1.198	49	1.510	74	2.042
25	1.208	50	1.526		

CHAPTER III.

TEMPERATURE, GENERATION OF HEAT, ETC.

MANY of the processes directed in the Pharmacopœia may be conducted on an ordinary cannon stove; as, making infusions and decoctions, syrups, some of the extracts, all of the ointments and cerates, and some of the plasters. The various kinds of cooking stoves are still better adapted to these purposes, each having its particular advantages, and nearly all offering facilities not only for performing the processes requiring the naked fire, but also being readily fitted with sand- and water-baths, and having ovens attached which answer the purposes of drying-chambers. Kitchen ranges, such as are now generally introduced into dwelling houses, are also adapted to the pharmaceutical laboratory; they may be so built as to allow of sheet-iron slides, or, better, metallic sash inclosing the space above the fire, so as to carry off the vapors from evaporating fluids, or the acid and other noxious fumes arising from chemical processes. If the iron slides are used, a light of glass should be introduced into one of them to facilitate the inspection of the processes, and these slides or the sash should be supported at such a distance from the fire as to allow of a draft of air above the containing vessels, and to enable the operator to manipulate without exposure to the fumes.

An advantage of these cooking ranges over stoves is found in the supply of hot water furnished by boilers or water-backs connected with them, a great convenience in a shop or laboratory. Drawings of these would be superfluous, as the situation and requirements of pharmacists are so various that each can best be suited by the exercise of a little ingenuity, and by availing himself of the experience and suggestions of those whose special calling is to furnish this kind of apparatus.

The work on *Pharmacy* by Profs. Mohr and Redwood, edited in Philadelphia by Prof. Procter, and that on *Chemical and Pharmaceutical Manipulations*, by Prof. Morfit, give drawings of different furnaces manufactured for the special uses of the chemist and pharmacist; but few of these are in common use, and it has not been deemed important to present the subject in detail in this work.

A notice of some cheap and portable forms of apparatus may appropriately preface an account of those pharmaceutical processes requiring heat.

The common clay furnace may be used in open chimney-places, or in the open air, charcoal being the fuel; a common bellows is employed when necessary to increase the intensity of the fire.

Similar furnaces are made of cast iron; they possess no advantages for use with charcoal, but, by becoming hot, they facilitate the combustion of anthracite.

The small French hand furnace, Fig. 109, is light and portable, and preferable to the ordinary clay furnaces for table operations.

Many of the operations of the pharmaceutical laboratory are conveniently performed with lamps, alcohol being the fuel. A neat and common alcohol lamp is that shown in Fig. 107; it has a

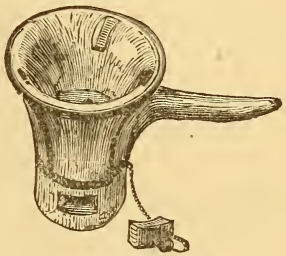
Fig. 107.

Glass spirit lamp.

Fig. 108.

Extemporaneous glass lamp.

Fig. 109.

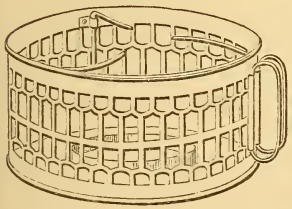


French hand furnace.

ground glass cap to prevent the waste of alcohol by evaporation. In the absence of such a lamp, a common glass bottle, with rather wide mouth, may be used; a perforated cork with a small glass tube about an inch long is inserted in the neck of the bottle, as shown in Fig. 108, and the wick is made to pass through this into the alcohol contained in the bottle.

A small tin alcohol lamp answers about as well as any for common purposes, with the exception of having no cap to prevent evaporation from the wick; such a one is shown in Figs. 110 and 111, with a convenient stand in which to place it under a capsule or other vessel to be heated.

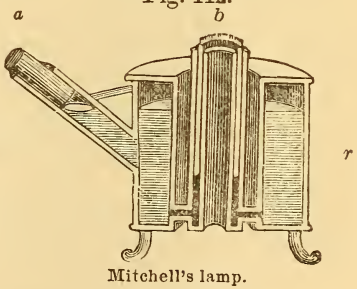
Fig. 110.



The alcohol lamp and stand.

Fig. 111.

Fig. 112.



Mitchell's lamp.

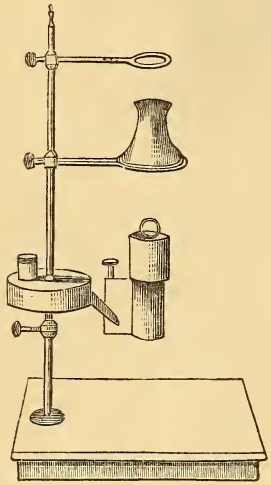
An alcohol lamp, familiar to chemical students, is Mitchell's argand lamp, shown in section in Fig. 112. In this, which is usually made of tin, an argand burner is placed in the centre of a cylindrical reservoir, *r*, with which it communicates at bottom by small lateral tubes; the reservoir is furnished with a tube near the top at *a*, for the introduction of the fluid; this is stopped with a cork

having a slight perforation, so as to admit the air as the alcohol is consumed. The cylindrical wick *b*, which is inserted in the burner, is kept saturated with alcohol, owing to its communicating with the reservoir. When lighted at its upper edge, it burns freely, having a draft of air within as well as without the cylindrical column of flame, and generates a large amount of heat.

When no longer wanted for use, the lamp should be covered by a cap over the burner, or emptied of alcohol, otherwise waste will occur by continued evaporation from the wick.

Fig. 113 represents Berzelius's lamp, which is adapted to alcohol or oil; it is attached to a permanent stand, upon the upright rod of which it moves, being secured by a screw, which presses against the rod; the reservoir is here separated from the burner, with which it communicates by a single tube. A little screw is arranged alongside the burner to raise or depress the wick.

Fig. 113.



Berzelius's lamp.

Fig. 114.

Lamp chimney.

Fig. 114 is a chimney, which is adapted to confine the flame within narrow limits, and to increase the draught, thus diminishing the tendency to smoke, and increasing the intensity of the heat. It may be applied either to Berzelius's or Mitchell's lamp.

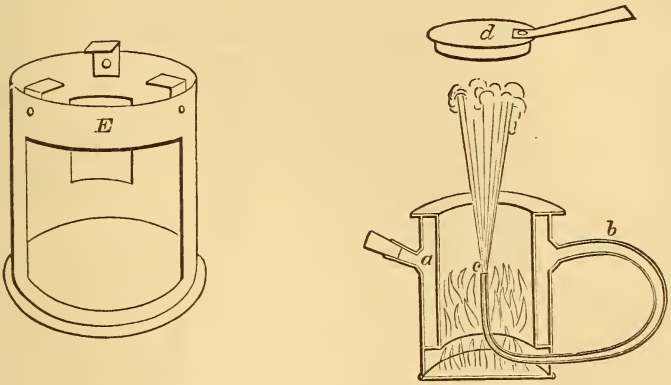
"The Universal Lamp," constructed on the same principle as Berzelius's, but better adapted to support utensils to be heated, may also be obtained from the manufacturers and dealers in chemical apparatus.

One of the best contrivances for generating an intense heat for those few processes in pharmacy to which it is essential, and for fusing insoluble silicates, and in glass-blowing and bending operations, is the lamp next figured, which is called the alcohol blast lamp.

This is shown in Fig. 115. It consists of a double copper cylinder, *a*, inclosed at top and bottom, and surrounding an interior chamber, which extends somewhat below the bottom of the cylinder to a permanent copper bottom, as shown in the section. Near the top of the cylinder, an open tube of the same material is soldered

on at *a*, for the purpose of filling it, and nearly opposite, on the other side, a tube, *b*, also of copper, is inserted; this is bent, as seen in the drawing, and, gradually tapering down to a small diameter, enters the internal chamber between the lower terminus of the

Fig. 115.

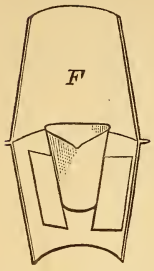


Alcohol blast lamp and stove.

cylinder and the bottom; it is now curved upward, and terminates with a small orifice at *c*; a movable top, *d*, is fitted with a handle, and so constructed as to fit over the open top of the chamber. *E* represents a sheet-iron stove in which the lamp may be placed when used, and which serves as a support for crucibles, dishes, etc. The mode of using this lamp is to fill the cylinder with alcohol by means of the tube *a* till it commences to run out of the jet *c*, then cork up the open end of the tube *a*, observing not to secure the cork too tightly. About two fluidounces of alcohol are now poured into the central chamber, or sufficient to cover the bottom and rise to within an inch or two of the orifice at *c*. This spirit, being now ignited by a match, quickly heats that contained in the surrounding cylinder, and as this boils, the vapor formed is forced through the tube *b* in a powerful jet, which, as it escapes at *c*, is ignited by the flame playing upon the surface of that in the chamber, and thus forms a jet of flame possessing an intense heating power; should any obstruction occur in the tube *b*, or at the orifice *c*, the apparatus might explode, but that the cork at *a* would be likely to be thrown out. When it is desired to stop the flame, and whenever the apparatus is to be put out of use, the cover *d* is placed on the top.

For accomplishing fluxions with carbonated alkali, where a very intense heat is required, this lamp is an admirable arrangement, doing away with the necessity of a counter blowpipe. In order to apply this jet to the greatest advantage for the purpose named, a crucible jacket, *F*, Fig. 116, may be placed upon the projections on the top of the stove *E*, Fig. 115, immediately over the flame of the

Fig. 116.



Crucible jacket.

lamp. This is a sort of chimney made of sheet-iron, and serving the double purpose of keeping the crucible from all currents of air but those highly heated by the flame, and of turning the flame back, somewhat as in a reverberatory furnace.

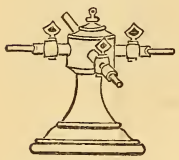
The cheap and abundant lighting fluids sold under the names of kerosene, coal oil, etc., are too highly carbonaceous to serve a good purpose for heating, unless with apparatus constructed with special arrangements for securing the thorough combustion of the oil and the convenient application of the generated heat to the objects in view.

Gasoline vapor is too smoky even when mixed with atmospheric air; but the kind of gas made by the destructive distillation of coal leaves nothing to be desired.

The best fuel for pharmaceutical purposes is the gas now so freely and cheaply supplied in almost every considerable town.

This gas may be conducted by pipes into the counter or table, and terminated at any convenient point just above its surface by a suitable burner; or it may have soldered on to the iron pipe at its terminus a leaden one, which, being flexible, may be moved at pleasure to any desired part of the table. The gas distributor, shown in Fig. 117, is the best arrangement for supplying a number of burners at one time on the table; it is made of brass on a marble foot, with three distributing stopcocks. This arrangement affords a neat and convenient means of using gas, from an ordinary pendant or bracket on the table, for three several purposes at the same time. A very good portable apparatus, capable of being used in any part of the room, or in any room in the house, is shown in Fig. 118. It consists of a flexible tube, which is terminated at one end by a cap to fit on to the burner of a common chandelier, pendant, or side-light, such as are suspended from the ceiling or walls of apartments for the purposes of illumination. To the other end of this tube is a stand of metal attached, surmounted by a burner to be adapted to some of the various kinds of furnaces to be described in the sequel.

Fig. 117.

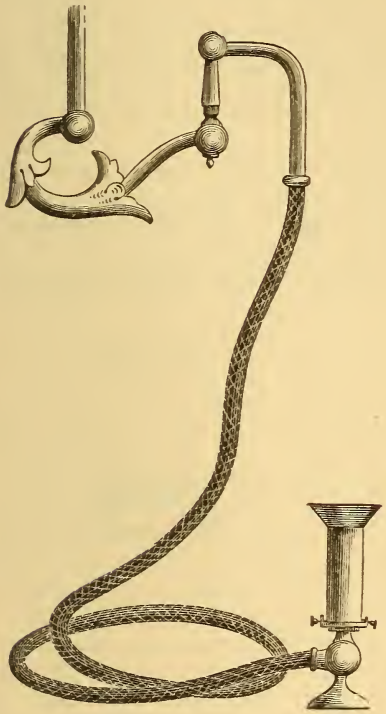


Gas distributor.

Figs. 119 and 120 are sectional drawings to illustrate the different modes of connecting the flexible tube as above with the permanent pipe. Fig. 119 is the mercury cup arrangement; a small cup is screwed on the burner at its base, into which are introduced a few ounces of mercury, and into this the cap of the conducting tube dips so as to form an air-tight joint, which is very readily shipped and unshipped. In this figure the cap is represented as having a flange covering the mercury cup, which, while it is in its place, protects the mercury from evaporation or from spilling out. When unshipped, however, the bath of mercury is unprotected, and becomes wasted, frequently requiring to be renewed, and leading to inconvenience. Fig. 120 is a ground burner and cap, such as are shown

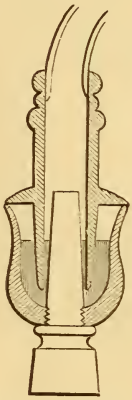
also in Fig. 118. The burner and cap are fitted and ground to each other, so as to make a direct air-tight connection when adjusted,

Fig. 118.



Ground gas burner and hose.

Fig. 119.

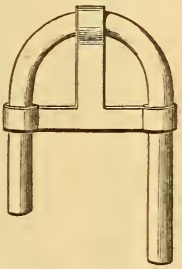


Gas burner with mercury cup and cap.

Fig. 120.

Ground gas burner and cap.

Fig. 121.



Curve for gas tubing.

and yet are removable at pleasure. The screws by which the burner is attached to the pipe, and the cap to the flexible tube above, and also the internal construction of the fish-tail-burner, are shown in this section.

There is now made a cap which fits upon any burner without being ground, and is used for drop-lights in illumination. These attachments are made by simply stretching a piece of gum-elastic tubing over the burner, and connecting the other end with a gas furnace or other appliance on the counter. There is a liability to inconvenience from the folding of the tube upon itself at the point at which it should curve, thus shutting off the flow of gas. To obviate this, a curved tinned iron support, shown in Fig. 121, may be slipped over the upper end of the tube into a position to give it the appropriate curve.

Fig. 122 represents the argand burner with rim. The jet of gas is here through the small holes at the top of the hollow cylinder,

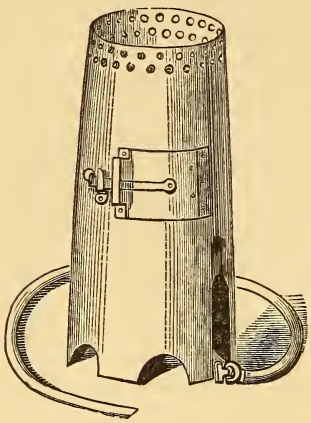
Fig. 122.

Argand burner.

the funnel-shaped appendage above being designed to spread the flame when used for illumination; the disk screwed on below is used to support the chimney, and is perforated with holes so as to allow a draft of air around the flame, while the hollow cylindrical shape of the burner favors the draft through its centre. The argand burner is shown in Fig. 118 as covered by a cylinder, Fig. 125.

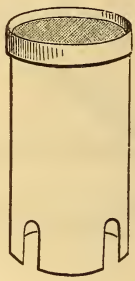
Fig. 123 represents a cylindrical screen used to cover over any common burner, the object being to confine the heat, to prevent the flame being affected by draughts, and to afford a support for the vessel being heated. The door is convenient, when the top is covered, to light the flame, and to see its elevation and depression during the process.

Fig. 123.



Screen and support.

Fig. 124.



Gas stove.

Fig. 124 represents a cylinder of sheet copper, iron, or tin, which may vary in length from 5 to 8 inches, and in diameter from $2\frac{1}{4}$ to 4 inches, with a ring of the same material about an inch wide, and just large enough to slide over the cylinder. A piece of copper or brass wire gauze, a little larger than the diameter of the cylinder, is stretched over the top, and secured by passing the ring over it; while the bottom is left open, and either supported on feet or made to stand directly upon the table, the lower margin being, as in this case, scalloped, so as to allow the free passage of air into it.

The obstruction to the free passage of the mixed air and gas which fine gauze presents, causes the large amount of carbon in the flame observed in many of these furnaces; the gas accumulates in the top of the cylinder to the exclusion of the necessary proportion of atmospheric air; a gauze of from 30 to 50 apertures to the

linear inch has the required fineness. The gas stove, as thus constructed, is to be set immediately over a gas pipe, which may either be permanent or flexible, or it may be open at the end, or terminated by an ordinary bat-wing, or fish-tail, or argand burner; preferably by the latter.

Fig. 125.

Small gas stove.

Fig. 125 is another form of cylinder, of tin: the bottom being removed, it will fit the rim of the argand burner; the object of the little cap at bottom is to adapt it to an ordinary fish-tail or bat-wing burner. Many restaurants are supplied with similar apparatus, its construction being varied, so as to give support to the vessel to be heated.

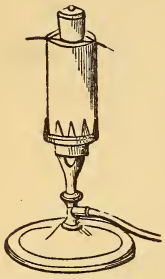
The mode of using these cylinders is to place them over the burner, and to allow the gas to escape into them and thus to become mixed with air, then to apply a light above the surface of the wire gauze. The gas, which, under ordinary circumstances, burns with a bright yellow flame, indicating the presence of carbon in a state of incandescence, and depositing, in consequence, a large amount of soot upon any cold body brought in contact with it, may now be so completely diluted with air, by regulating the jet, as to burn with a light blue flame, containing no carbon. The combustion being much more complete, and spread over the whole surface of the gauze, gives an increased amount of heat, and so diffuses it over the bottom of the vessel as to diminish the liability to fracture. Where a smoky flame is obtained, the supply of atmospheric air should be increased, or that of the gas diminished.

This kind of heating apparatus, when the fuel is accessible, is recommended by its cleanliness, as, when carefully used, it is as free from any residue or sooty deposit as alcohol itself. Gas is far cheaper than alcohol, even in towns where the price reaches $4 00 per thousand feet. In Philadelphia it is but $2 50. It may be applied for an indefinite period without renewing, which in long evaporations is particularly desirable. It may also be regulated with perfect facility, and left burning during the absence of the operator, without the fear of a material increase or diminution of the flame, thus superseding, in many instances, the necessity of a sand-bath, to be described in a subsequent chapter. The reader may consult with advantage the papers of P. W. Bedford, in *Proceedings Amer. Pharm. Assoc.*, vol. xiii. pp. 155, 180.

In some gas furnaces the rim used to secure the wire gauze over the top is made to project for a half inch or more above the gauze, and the inclosure is filled with pieces of pumice-stone or of brick about the size of a chestnut; the advantages of this are, that the flame is not so liable to be blown out by a draught of air, the rim acting as a shield to it; the incombustible material becoming hot, radiates heat besides the direct heating effect of the flame. It also protects the wire gauze from corrosion by liquids accidentally spilled, and diminishes the liability to its becoming so perforated that the flame may be communicated to the mixed gas in the interior of the stove.

If the cylinder rests on the table, and is short, so that the fire is brought near the top of the table, the heat will scorch, and may inflame it. To avoid this, elevate the top of the cylinder, at least eight inches, or place it and the burner on a plaster tile. Putting a wire-gauze diaphragm between the gas burner and the top of the stove, with the view of mixing the gas and air more completely, seems unnecessary.

Fig. 126.

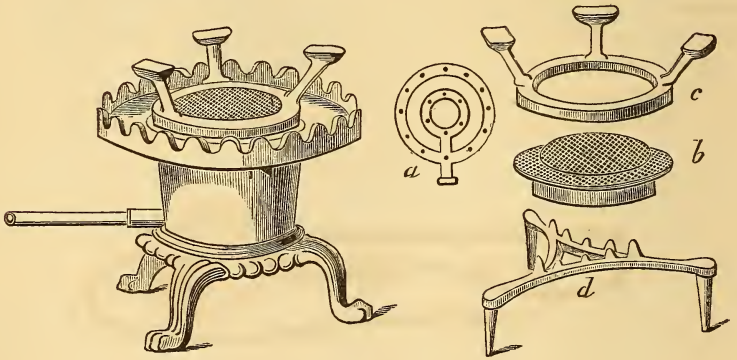


Chimney and crucible support.

In those instances where a gentle heat is required, and especially when the vessel to be heated is small, the cylinder covered with wire gauze may be dispensed with, and an argand burner being used, a small chimney of metal or glass is set on its rim, as shown in Fig. 126; and, the jet of gas being small, and the object removed some distance above the flame, a steady and continuous heat is secured without a deposit of soot.

Parrish's gas furnace, shown in Figs. 127, 128, is of cast iron, open at the bottom, of the shape shown in the drawing. A brass burner of two rings, *a*, Fig. 128, passes into the body of the furnace near the bottom; the rings are perforated at suitable distances with small holes for the ignition of jets of gas. For all purposes requiring a moderate and diffused heat, this answers an admirable purpose. The scalloped rim allows the free passage of a draught of air from the flame when the furnace is covered by a receiving vessel, while the distance of this from the flame prevents the deposit of soot upon it unless when the flame is at its highest, which it need not be for the purposes named.

Fig. 127. Fig. 128.



Parrish's gas furnace.

Fig. 128 represents the wire-gauze attachment, adapted to operations requiring a high heat; the lower casting, *b*, fitting accurately into the throat of the furnace, is covered with wire gauze, which is secured in place by the upper, *c*; this has three projecting arms for supporting the receiving vessel at the right elevation from

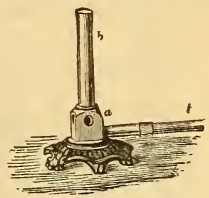
the flame. The small tripod, *d*, is useful for supporting smaller vessels and flasks, either when subjected to the high flame or to that designed for evaporation.

Being open at the bottom, this furnace allows a free ingress of air to mix with the gas, which, being ignited above the diaphragm of wire gauze, produces perfect combustion without the least smoke, and with greatly increased evolution of heat. The greatest consumption of gas by this burner, under ordinary pressure, is from seven to ten cubic feet per hour, though this would smoke without the wire-gauze attachment; for evaporation without the attachment a much smaller flow of gas is required.

A gallon of water in a pharmaceutical still of tinned iron, placed on the projecting arms over the wire gauze, was raised to the boiling point in thirteen minutes, though in an uncovered enamelled iron vessel it required nearly twenty minutes. In this, as in all other apparatus for burning gas, much depends on the flow of the gas, which is partly regulated by the stopcock, and partly by the pressure at the works.

Bunsen's burner, Fig. 129, is familiar to most chemical students as furnishing a concentrated flame similar to that produced by a blowpipe, and useful for fusions, for blowing and bending glass, for bringing a crucible to redness, and for many purposes in the laboratory. For blowpipe operations the upright tube is fitted with another one, which is flattened laterally at the upper end, so that the orifice presents the appearance of a narrow slit, which, being cut off obliquely, gives to the blowpipe flame a downward direction. The tube of Bunsen's burner may be covered with a cylinder or support; as the mixture of gas with atmospheric air is effected in the tube, this arrangement is not liable to the disadvantage of imperfect combustion.

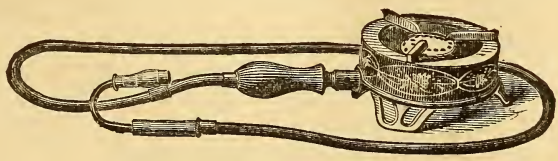
Fig. 129.



Bunsen's burner.

A modification of Bunsen's burner, Fig. 130, has been devised, in which most of the tube conveying the gas mixed with air is

Fig. 130.



Horizontal burner.

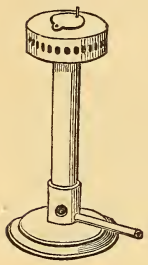
kept in a horizontal plane, and the perforated head attached to a short pipe at right angles to the horizontal tubes. The operator is enabled to employ it in many cases where the usual upright tube is inadmissible.

Another arrangement for the same purpose is to cover merely the upper end with a short cylinder fastened on a retort stand,

the top of which is covered with gauze; or, a still cheaper one, to place a piece of gauze upon the ring of a retort stand. In both these cases the gas may be lit either above or below the gauze, and the flame spread over its diameter or confined below it at pleasure.

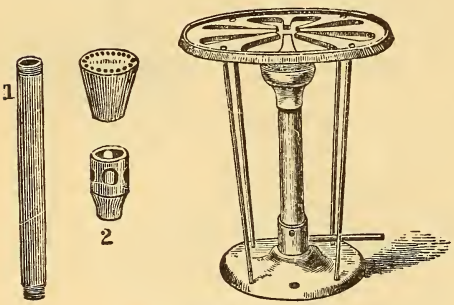
Bunsen's burner has been modified by J. J. Griffin, F.C.S., whose modification is figured in the *Chemical News*, London, November 2, 1861. This arrangement is shown in Fig. 131. The most important improvement suggested by Griffin is a movable cap fitting over the air-box at the bottom, with holes so arranged as to diminish the supply of air at pleasure. A modified Bunsen burner with this arrangement is now sold by dealers in chemical apparatus; it can be adjusted to produce a yellow carbonized flame or an intense blue flame at pleasure, and is regulated with ease so as to prevent either an excess of gas or of air. The principle of Griffin's attachment of a circular cast-iron box, with holes around the margin and on the top, designed to surmount the Bunsen burner and spread the flame for boiling and evaporation, was, I think, anticipated by McGlensey, of Philadelphia, whose patent burner is figured below.

Fig. 131.



Griffin's burner.

Fig. 132. Fig. 133.



McGlensey's gas burner.

Fig. 132 (1, 2) shows a simple brass cylinder with attachment for the introduction of gas and atmospheric air. The orifice of the burner is about one-quarter of an inch above the top of the holes for the admission of air, an important feature in determining the degree of force of the upward column of mixed air and gas; this constitutes a Bunsen burner. The perforated conical top-piece is designed to be screwed on to the top of the tube, and spreads the flame by discharging the gas through the small orifices in the top. In other patterns of this, designed for larger tubes, this perforated disk is convex, and some of the holes are so near the outer edge as to spread the flame more thoroughly. Fig. 133 shows one of the numerous arrangements adopted by the patentee for the support of vessels over the burner. Various forms of apparatus constructed with McGlensey's improvement are used for heating sad-irons, the cast-iron plates for batter cakes, and for radiating heat, as in warming bath-rooms and other small apartments. For boiling they are useful, but not so well adapted for evaporation. It is claimed that one of them will boil a quart of water in a tin vessel in ten minutes, burning at the rate of four cubic feet of gas per hour.*

* See paper by Prof. P. W. Bedford, Proceedings of American Pharmaceutical Association, xiii. 155, 180.

CHAPTER IV.

ON THE MODES OF MEASURING, REGULATING, AND APPLYING HEAT FOR PHARMACEUTICAL PURPOSES.

Thermometer.—The measurement of temperature, which is of practical importance in some heat operations, and in ascertaining the specific gravity of liquids, is effected by the use of a thermometer. These, as made for the measurement of ordinary changes in the temperature of the atmosphere, are of various cheap patterns, generally having a small range from a few degrees below zero of Fahrenheit, to about 120° above it. Fig. 134 represents a thermometer such as is convenient in a chemical or pharmaceutical laboratory. It is graduated by Fahrenheit's scale from —20° to +640°, and adapted to immersing in liquids the temperature of which is to be measured.

Fig. 134.

Thermometer.

In the United States and Great Britain, Fahrenheit's scale is popularly used; but as the student is liable to see Centigrade and Reaumur's scales referred to in works written in continental Europe, and as the former is generally introduced into chemical laboratories everywhere, and is mentioned in modern works on chemistry, a description of these is necessary, with the mode of converting them into Fahrenheit's.

The Centigrade scale is the best adapted to the wants of the scientific, by its decimal arrangement; in it the freezing point is zero, and the boiling point of water 100°, each degree being equal to 1.8 Fahrenheit's.

Reaumur's scale has the boiling point of water at 80°, the zero being at freezing; it has been superseded, where it was formerly used, by Centigrade.

Fahrenheit's has the zero 32° below the freezing point, and 180° between freezing and boiling, so that the latter point marks 212°.

To reduce Centigrade to Fahrenheit's, multiply by 9, divide by 5, and add 32. To reduce Fahrenheit's to Centigrade, subtract 32, multiply by 5, and divide by 9.

To reduce Reaumur's to Fahrenheit's, multiply by 9, divide by 4, and add 32. To reduce Fahrenheit's to Reaumur's, subtract 32, multiply by 4, and divide by 9.

The following diagram illustrates the relation of these three scales to each other. Those who wish can

consult tables of equivalent temperatures in Gray's *Supplement to the Pharmacopœia*, folios 61–63.

Fig. 135.

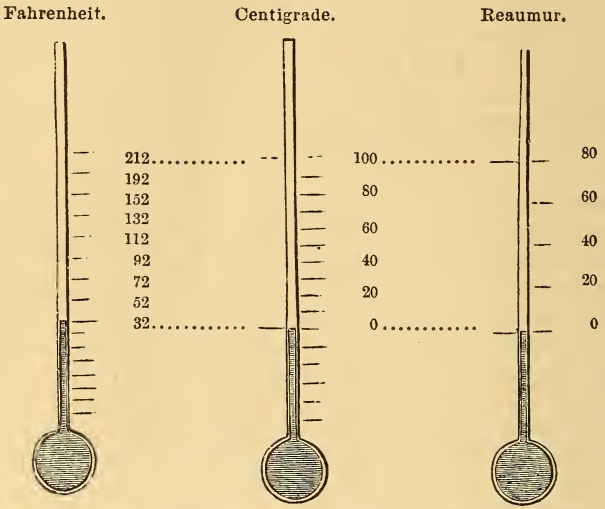


Diagram of different thermometers.

In most of the operations of the pharmaceutical shop and laboratory, the intervention of some conducting medium, between the fire and the vessel in which the operation is performed, is useful, either to prevent its too sudden elevation and depression of temperature, or to regulate the degree of heat applied. For these purposes, sand-, water-, and steam-baths were invented.

The Sand-Bath.—This is used to prevent the sudden elevation and depression of temperature, and where arrangements for burning gas, such as are described in the last chapter, are at command, it may be dispensed with in nearly all cases. A convenient sand-bath, at all times ready during the winter season, is furnished by the top of a stove, such as is used with anthracite coal for warming apartments; a rim of sheet iron, stretched around the top and projecting from three to four inches above it, makes a good receptacle for the sand, which becomes more or less heated according as the fire is increased or not, and may be used to digest infusions, to dry precipitates, and to evaporate any solutions the vapors of which would not contaminate the atmosphere injuriously. A shallow cast-iron pot, fitting, though not too closely, the top of a stove or furnace, is also a good arrangement; this is to be filled only so full of sand as is necessary completely to cover the bottom of the vessel to be set in it; as a general rule, the greater the amount of sand, the greater will be the waste of heat. In introducing a vessel to be heated, it may be plunged into the sand, so as to cover the bottom and sides more or less, according to the degree of heat required; and when the diameter of the sand-bath is greater than that of the fire below,

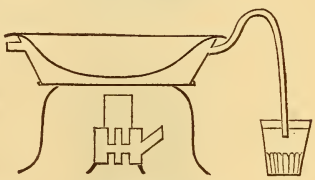
there is a similar choice between placing it immediately over the source of heat, or in a less heated position near the edge.

The Water-Bath.—An extemporaneous water-bath is prepared by procuring a rather shallow tin or copper cup, and an evaporating dish of just such size as will completely cover it, projecting slightly over its edge. Those glass evaporating dishes which have a projecting edge turned over and downwards will fit more securely over the metallic vessel without being pushed out of place by the force used in stirring. They are also convenient from not allowing the ready escape of steam round the edge; this, being condensed, either passes back into the cup, or drops from the edge.

The lower vessel is to be nearly filled with water, and the substance to be heated placed in the evaporating dish, which being adjusted to its place, the whole is put over the fire.

The temperature of boiling water under ordinary circumstances of pressure being 212°, it is obvious that the contents of the evaporating dish cannot reach a higher point; it is found, practically, that two or three degrees of heat are lost in passing from the boiling water through the dish, so that, when the water below is boiling, the temperature of the contents of the dish will not exceed 210°. Aqueous liquids will not boil in a water-bath, but many of the solutions used for the preparation of extracts, being alcoholic, undergo active ebullition at this temperature.

Fig. 136.



Metallic water-bath.

A disadvantage attending upon an extemporaneous arrangement arises from the rapid escape of steam from the lower vessel on all sides of the capsule: now the quantity of vapor which will be suspended in a given space in the atmosphere is constant at any given temperature, so that, in proportion as such space is saturated with moisture, further evaporation is retarded.

A convenient water-bath, less liable to the above objection, is here figured; it is constructed of tinned iron, or preferably of copper tinned, and consists of an outer vessel or jacket soldered on to a shallow dish made like a porcelain capsule, without seams, coated with tin, designed to contain the evaporating solution. The jacket is fed with water by the tube, which may be fitted more or less tightly with a cork. It is tightly corked when the vessel is to be tilted in pouring off the contents of the upper part of the vessel, but loosely during the application of heat. In drying substances, and in all cases where it is desirable to prevent the escape of steam from the water in the jacket into the surrounding air, the cork may be perforated and fitted with a steam-pipe of glass conducted into a vessel of cold water (Fig. 136), into the flue of a chimney, or through a window.

Fig. 137.

Porcelain water-bath.

When put out of use, the water-bath should be carefully dried by wiping out the upper or evaporating vessel, and placing it in such a position that the jacket will be completely drained of its moisture.

By adapting to the cork, as above, a tube of glass, and passing it into a vessel of mercury, steam may be obtained under pressure so as to raise the temperature of the bath somewhat above 212°, and this arrangement may be resorted to with advantage when a more rapid evaporation is desirable than that afforded at the ordinary water-bath temperature. Steam with regulated pressure is applied on a large scale in a variety of manufacturing processes, as explained in the sequel.

Fig. 138.

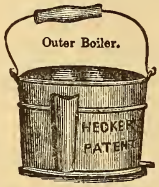
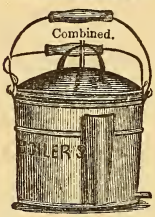


Fig. 139.

Fig. 140.



Hecker's farina boiler.

Fig. 137 shows a porcelain water-bath, sold by the importers of Berlin ware, which is too small except for experimental purposes, or for the preparation of very small quantities of extracts or chemical products; it is, however, very convenient in these cases, and not liable to corrosion.

Figs. 138, 139, and 140 represent the so-called Hecker's farina boiler, which is useful for the preparation of farinaceous articles of food, particularly where milk is employed; it obviates the danger of scorching, which is constantly experienced in heating milk over a naked fire. Fig. 138 is an outside tin vessel with a spout for the ready introduction of water. Fig. 139 is the inner vessel fitting into the above for containing the farinaceous substance, and Fig. 140 shows the two as fitted together.

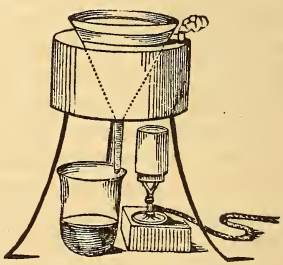
Fig. 141 represents a little apparatus for applying the principle of the water-bath to drying precipitates on filters; it consists of a kettle of water, surmounted by a steam jacket surrounding a funnel, which is closed at bottom, so that a substance laid into it is heated to about 212° when the water reaches the boiling point.

Fig. 142 illustrates the application of the water-bath to filtering

Fig. 141.

Water-bath for drying filters.

Fig. 142.



Apparatus for hot filtration.

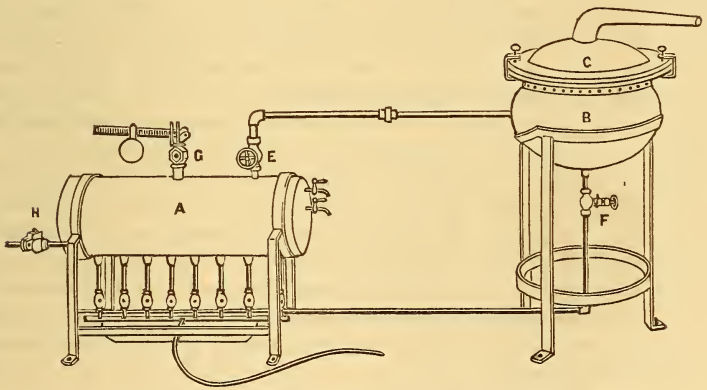
liquids while hot. Physick's jelly strainer, described in the chapter on Filtrations, operates on the same principle.

The Steam-Bath.—A steam boiler, by arranging pipes to communicate with suitable forms of apparatus, and by adapting the fittings and safety valve so as to regulate the pressure, may be made to supply the heat necessary for the processes of boiling, evaporating, digesting, distilling, drying, and even for heating apartments.

In manufacturing establishments this is now generally adopted as the chief or only means of generating and applying heat, and its applications are so varied that it constitutes one of the leading topics of illustration and description in works on technology. The design and scope of the present work do not include the details of costly apparatus, and it will be sufficient here to advert to the principle on which steam-baths are constructed, and illustrate a practical apparatus for ordinary pharmaceutic use.

Fig. 143 exhibits a steam boiler and still devised for the use of pharmacists where it is inexpedient to use large steam boilers.

Fig. 143.



Steam boiler and evaporating pan with steam jacket.

This apparatus is adapted to the same purposes as the pharmaceutical still, and for operations requiring a regulated temperature above that of a water-bath. A is a boiler of thick copper, capable of bearing high pressure; it is one foot nine inches long by seven inches in diameter, held in position by an iron frame, and heated by a stand of Bunsen burners, supplied with gas through a flexible tube; seven burners are found sufficient. The water supply-pipe on the extreme left is furnished with a valve at H, which closes when sufficient water is contained in the boiler; the water flows into this pipe through a flexible tube connected with a hydrant, or it may be filled from any vessel by the use of a funnel, the air having vent, and the elevation of the water being ascertained by means of the gauge cocks at the other end of the boiler; G is a safety valve, and E and F are cocks for regulating the flow of steam. The boiler is connected by iron pipes, coupled together, with the steam jacket B,

which surrounds an evaporating pan of tinned copper; this is secured to the dome C by means of brass flanges and clamps, between which a coil of common lampwick is interposed, rendering the junction steam-tight. The drip from the steam jacket may lead to an adjacent sink or be discharged in any receiving vessel; it supplies an abundance of distilled water of sufficient purity for ordinary use. When this apparatus is used for distillation, it requires to be connected with a suitable condenser. A jacket of galvanized iron should be placed over the boiler, leaving a space of an inch on all sides so as to confine the heated air around it.

As already stated, water boiling under ordinary circumstances of pressure does not exceed the temperature of 212° F., and the utility of the water-bath is limited to processes in which that degree of heat is sufficient; but if water be boiled under pressure, the temperature rises in direct and invariable proportion to the pressure, and in this way may be rendered available with great facility and certainty in processes in the arts.

In most almshouses, prisons, insane asylums, and hospitals, arrangements are made for the introduction of steam pipes either directly into the apartments to be warmed, or, preferably, into air chambers through which fresh air is made to pass by a system of ventilation into the several parts of the building. The two methods are also advantageously combined. The boiler being located in a fire-proof basement, or at a suitable distance from the main building, the danger of conflagration is greatly lessened.

To the physician, the study of these properties of steam, in their applications to the warming and ventilation of public buildings, is even more interesting and important than their manifold uses in pharmacy and the industrial arts, and it is to be regretted that no means of systematic instruction upon these and kindred matters of public utility are placed within the reach of those who are so liable to be called upon for advice in relation to what might be called architectural hygiene.

PART III.

INORGANIC PHARMACEUTICAL CHEMISTRY.

CHAPTER I.

CHEMICAL PROCESSES USED IN PHARMACY.

In presenting to view the medicines derived from the mineral kingdom, such preliminary details will be given in regard to those which fall within the range of the shop as shall render their preparation as easy and as uniformly successful as possible, while those derived from the manufacturing chemist will be described chiefly with reference to their uses and the modes of ascertaining their purity, with incidental references to their sources, modes of preparation, composition, and rationale.

Some of the chemical substances among the *preparations* in the Pharmacopœia are rarely made by the apothecary, while those in the *list* are chiefly interesting to the pharmaceutical student as illustrating the laws of chemical reaction, and as showing the marvellous agency of chemistry in meeting the requirements of medical science. Much of the detail appropriate to works on technology, being destitute of practical value to the class for whom this book is mainly written, will be omitted.

The laws of chemical reaction, of such utility not only to the physician and pharmacist, but to every individual of whatever profession or pursuit, although not falling within the scope of the present work, are recommended to the careful study of its readers.

The fact, which underlies the science of chemistry, that chemical substances combine with each other in definite proportions, forming compounds, the combining proportions of which are always equal to the sum of combining proportions of the elements they contain, is among the first to be thoroughly mastered by the student; and he will find advantage in the study of the numbers given along with the symbolic formulæ under each heading contained in Part III. These have been revised for the present edition in accordance with the views of modern chemists.

Nothing so facilitates the acquisition of scientific knowledge as an intelligible, concise, and familiar nomenclature. This has been the subject of much discussion recently, and an attempt has been made to modify the nomenclature of the Pharmacopœia to correspond with recent chemical works.

Notwithstanding the elementary and practical character of this work, I have not hesitated, as in former editions, to employ the

abbreviated method of notation in use among chemists, by which the rationale of the formation and the composition of complex bodies is expressed by clear and intelligible symbols with numbers attached to designate the equivalent proportions of the elements concerned. The composition and relations of compound bodies can only be shown at a glance in this way, and it is earnestly recommended to the pharmaceutical student that he will in no case neglect to address himself to a full comprehension of these symbolic formulæ, as a necessary groundwork of his studies.

The recent modifications of the views of chemists have resulted in the introduction of new formulæ. For expressing these, which as they are now used in the chemical text-books are so different from those formerly in use as to produce some confusion in the minds of those educated a few years ago, we have generally given both; but their full explanation would extend the text beyond the plan of this work, and the student is referred to Dr. Attfield's *General and Pharmaceutical Chemistry*, a work written with especial view to the needs of the student in this respect.

Chemical Processes.

By way of preface to the study of the modes of preparation of the chemical substances treated of in the subsequent chapters, the following brief description of some chemical processes, the most of which are practicable on a small scale in the pharmaceutical laboratory, is appended:—

1st. Processes of separation founded on volatility.
Distillation, Fractional Distillation, Destructive Distillation, Sublimation, Dehydration, Calcination, Ignition, Torrefaction.

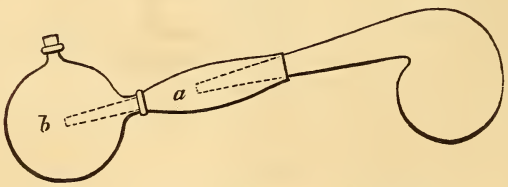
2d. Processes of reduction and absorption.
Reduction of Oxides, Oxidation, Generation and Absorption of Gases.

3d. Processes of purification.
Decoloration, Washing, Decantation, Filtration.

4th. Collection of chemical solids.
Granulation, Crystallization, Precipitation, Fusion.

Distillation, when conducted in a small way, is chiefly accomplished by the use of glass retorts, with or without receivers or other means of condensation.

Fig. 144.

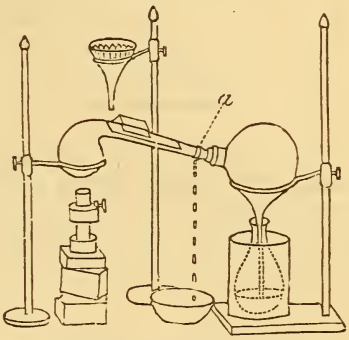


Plain retort, tubulated receiver, and adapter.

Fig. 144 exhibits a plain retort with an adapter *a*, by which it is connected with a tubulated receiver *b*, thus furnishing the two conditions of an apparatus for distillation (see page 110)—a vessel for heating a liquid to be distilled, and a surface to be refrigerated for the condensation of the vapor formed.

The substance to be distilled being introduced into the retort and heat applied, the vapor given off passes at once into its beak or neck, and, if this is not refrigerated, into the receiver. In some cases, particularly in treating very volatile liquids, it is found more convenient to apply cold directly to the beak, as in Fig. 145, in which pieces of linen or cotton cloth, folded several thicknesses and laid lengthwise on the beak, are kept constantly wet by the dropping of water from a funnel suspended above it. At the point *a*, below the lower edge of the wet cotton, a piece of lampwick, or waxed string, is tied tightly round the beak, to conduct off the descending water. The receiver here shown, though not tubulated as in the other plate, is quilled or drawn out into a fine tube, which enters the receiving vessel below; this, being fully refrigerated, insures the complete condensation of the liquid.

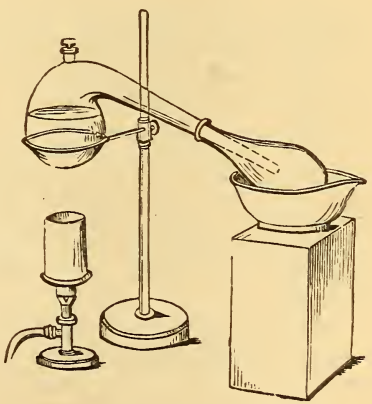
Fig. 145.



Retort with quilled receiver.

When the liquid to be distilled will condense at a moderate elevation of temperature, the mode of refrigeration last mentioned is conducted without the use of a receiver, the distillate being collected directly from the beak of the retort, from which it drops as fast as it accumulates. Sometimes the receiver is refrigerated, and not the beak of the retort, and this is perhaps the most common arrangement for retort distillation. It is shown in Fig. 146, which represents a plain retort, a common flask adjusted to it as a receiver, and set into a basin, which, by being kept filled with water, would also facilitate the refrigeration of the flask by wet cloths laid upon it. Where this arrangement is adopted, care should be taken not to secure the beak of the retort tightly into the neck of the receiver, in which case the expansion of the heated

Fig. 146.



Distillation with tubulated retort and receiver.

air and vapors, on commencing the operation, would lead to a rupture of some part of the apparatus.

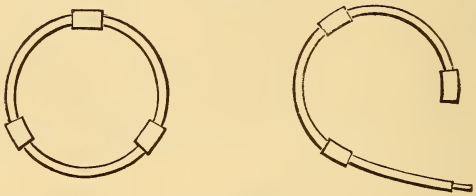
The plain retort is almost superseded of late years by the tubulated, which has the advantage of allowing the more ready introduction of substances to be distilled, and, by loosening the stopper, the prevention of accidents from the too great tension of the vapor, and from the too sudden refrigeration of the retort, which would cause some condensed distillate to flow back, endangering the safety of the retort.

Fig. 147.

Tubulated retort.

A little ring, made frequently of straw and bound with twine, known to chemists as a grummet, furnishes an excellent rest for flasks and retorts, which would be likely to be fractured if set upon any substance that conducts heat rapidly. A recent improvement in this article, shown in Fig. 148, is to make it of India-rubber hose joined by passing the two ends over a plug of wood which fits

Fig. 148.



Grummet.

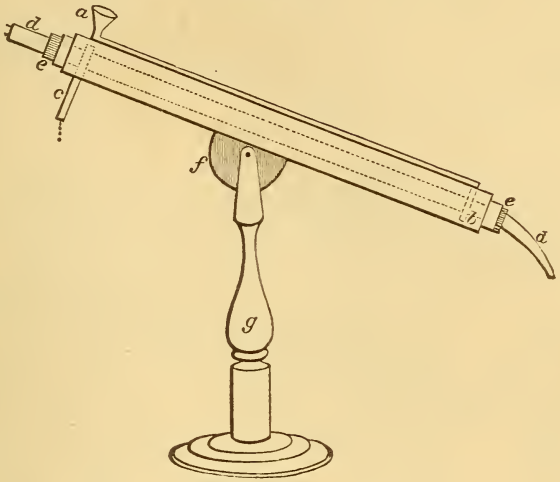
tightly into it. To make it more satisfactory, however, three short transverse sections of similar hose, of a size sufficiently large to pass over the hose composing the ring, are placed one over the joint and the others at equal distances apart. This arrangement permits a circulation of air around the bottom of the flask, or if the flask is placed in a water-bath a constant yet quiet circulation of fluid takes place around it. For a full description see paper of Dr. Squibb in *Proceedings of Amer. Pharm. Assoc.* for 1873.

Fig. 149 represents the well-known Liebig's condenser, which may be constructed on a variety of patterns, and of different materials.

It consists of a tin tube 18 inches long and $2\frac{1}{2}$ inches in diameter, and having the ends reduced to $1\frac{1}{4}$ inch. The funnel *a* is the upper termination of a very small tin tube, which, passing down the whole length of the apparatus, enters it near the lower extremity, where it is extended by a bent leaden tube, as shown by the dotted lines, to the very bottom, at *b*. A short piece of thin lead pipe, *c*, leads from near the apex of the condenser, and, passing

out through a perforation into which it is soldered, terminates about two inches below. *dd* is a glass tube one inch in diameter, drawn out and bent at its lower end, which passes through the

Fig. 149.



Liebig's condenser.

whole length of the apparatus, being secured at either end by the perforated corks *e e*, which must be perfect and as soft as can be obtained. *f* is a stout piece of sheet copper soldered on to the main tube, and made to work by a screw upon the wooden upright *g*.

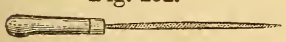
A smooth and even perforation may be made by a brass cork-borer, Fig. 150, or a rat-tail file, Fig. 151, or both, so as to constitute a water-tight joint. A shoemaker's file, which is a straight cut file on one side, and a rasp on the other, one half being curved on the face and the other half flat, will be found to be of great advantage in fitting corks to the different uses they are to be applied to.

Fig. 150.

Set of cork-borers.

The use of cement or luting to surround the cork is necessary if they are not very perfect and very completely fitted, and as no alcoholic liquids will come in contact with them, dissolved sealing-wax is found to answer a good purpose. Gum-elastic perforated stoppers may be advantageously substituted for corks, and require no luting. The expense of a condenser such as here described is from $3.50 to $5. The bottom of the wooden stand should be grooved on the under side and filled in with melted lead, to prevent the ill effects of warping, and to give solidity to the whole.

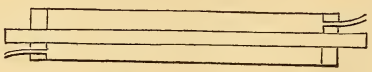
Fig. 151.



Rat-tailed file.

Fig. 152 represents Liebig's condenser made entirely of heavy glass tubes, fitted together by means of perforated gum-elastic stoppers. The cold water supply and discharge pipes consist entirely

Fig. 152.



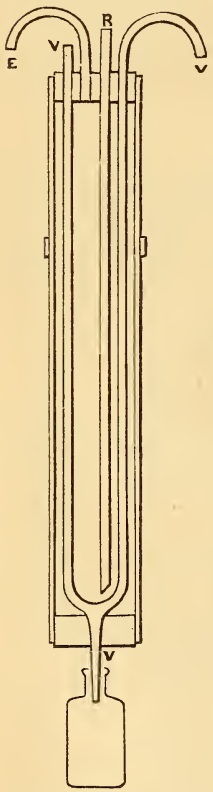
Liebig's condenser, of glass.

Fig. 153.

Stand for condenser, of glass.

of gum-elastic hose; the end tube is not bent or drawn to a small opening, and may be cleansed with facility by a swab. The chief disadvantage of these is their liability to breakage from rough handling or sudden changes of temperature when in use. They are very neat, however, and with care serve a good while. Fig. 153 is a convenient form of condenser stand, which, by raising and depressing either end, gives the proper inclination to the tube. Where there is a deficiency of room on the operating counter, the condenser may be hung from the ceiling or from brackets, being drawn into position when needed. A tin trough is a good support under these circumstances.

Fig. 154.



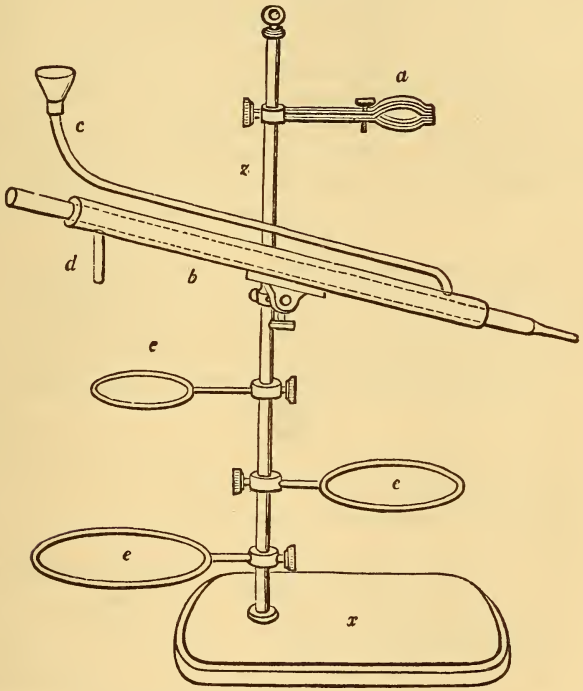
Squibb's upright condenser, of glass.

The objection due to the space taken up by Liebig's condenser upon the operating table has been overcome by Dr. E. R. Squibb by an arrangement in which the vapor tube is doubled, forming a U, shown in Fig. 154. This arrangement, besides, renders the condenser more effective. The outer lines represent the water case tube, v v the vapor tube of U shape, with a small opening at the lower end from which condensed liquid escapes to a proper recipient, while any uncondensed vapor passes to the other leg of the tube, and is there condensed by the cooled surface and downward flow of condensed liquid. R is the refrigerating tube, descending to the lower end of the water case, through which cold water is supplied; while E is the exit tube for the refrigerating water after it has performed its function. The apparatus is supported by a ring and suitable clamp in the general apparatus holder, devised by Dr. Squibb, and hereafter to be noticed. A more lengthened description will be found in *Proceedings of American Pharmaceutical Association*, vol. xxi.

Fig. 155 represents a condenser supported on a retort stand, having freedom of motion in every direction; *x* is a cast-iron foot, in which is fixed a solid rod of iron *z*. The condenser, as here represented, is designed to be

made of brass, with a glass tube fitted into it with corks, as in the other case; the comparative size of the outer tube, as here shown, is much smaller, which requires a much more rapid passage of the cold water through it, especially in distilling very volatile liquids. The Gay-Lussac holder *a*, and the rings, are usually made of brass in this arrangement.

Fig. 155.

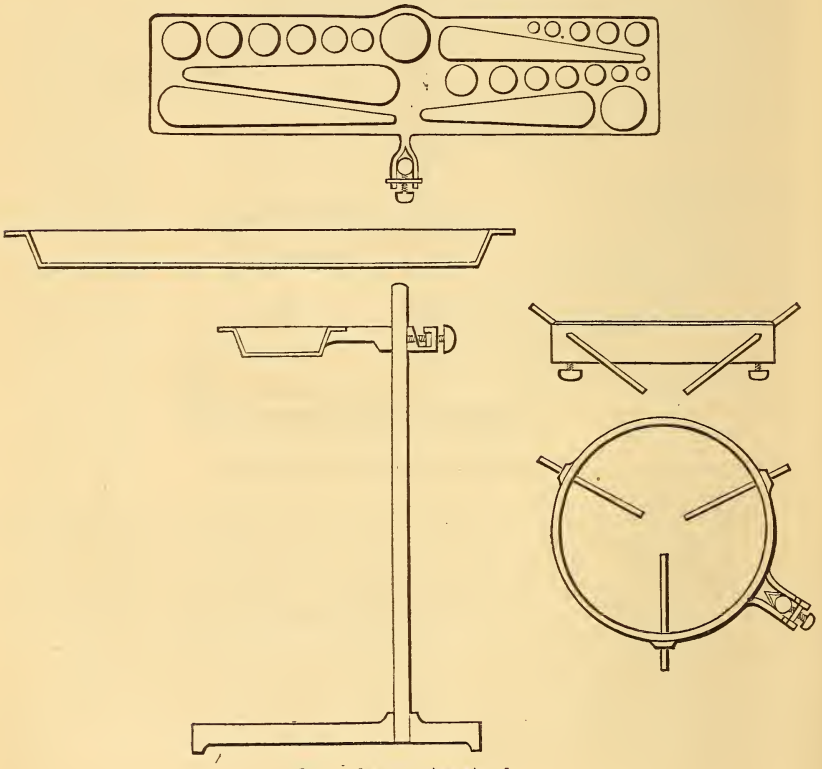


Liebig's brass condenser in retort stand.

A mechanical support for the retort and refrigerating apparatus is, of course, absolutely necessary in the arrangement of the distillatory apparatus. At least *one retort stand* is quite necessary, even in connection with the Liebig's condenser, Fig. 155; in which case one of the rings might have a sufficiently long handle, connecting it with the screw that clasps the upright rod, to hold a retort or a flask at a sufficient distance from the condenser to be adjusted to it for use; but this is not the case with any that I have seen, and would render the whole apparatus unsteady when loaded with the liquid. In Fig. 145, it will be seen that as many as three retort stands are used in a small operation. The frequent necessity for using several retort stands in one operation, and its consequent inconveniences, induced Dr. E. R. Squibb to devise what he has justly termed a general apparatus stand; which consists of a cast-iron plate 9 by 15 inches, into which near the centre an upright wrought-

iron pipe, $\frac{3}{4}$ inch external diameter, is firmly secured. A round-bottomed circular sand-bath, with a horizontal flange around the brim, notched to receive wires for fastening any vessel in the bath, is attached to a suitable and peculiar clamp, which grasps the upright rod and thus supports it in its place. In two adjustable rings, of cast-iron, three movable rods are made to slide to or from the centre, through holes made at equal distances apart; these rods are square and are fixed in any desired position by thumb screws; their direction is somewhat oblique to the horizontal plane of the rings. The rings may be placed upon the rod with the thumb screws up or down, and are secured by the same device to the supporting rod. A long sand-bath, 6 by 17 inches, and $\frac{3}{4}$ inch in depth, is attached to the rod in the same manner; it may also be used as a drying table. Two thin cast-iron plates, $16\frac{1}{2}$ inches long by $3\frac{1}{2}$ wide, also arranged with clamp to attach to the upright rod,

Fig. 156.



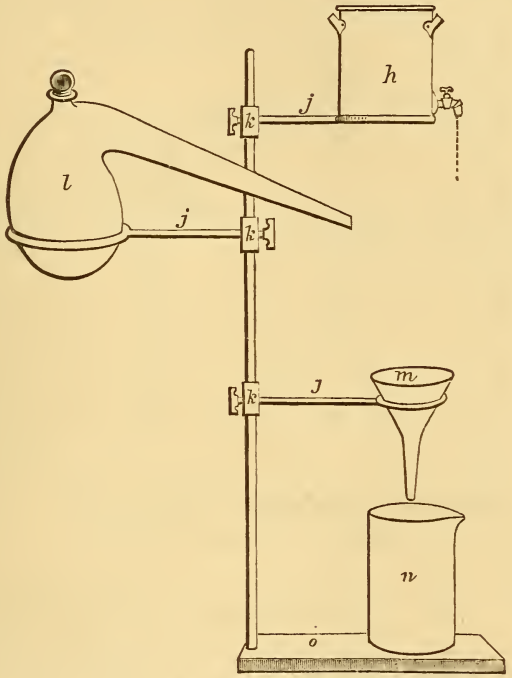
General apparatus stand.

are perforated with a number of holes of various sizes, and four slots of gradually increasing width furnish ready means of supporting test-tubes, flasks, and a variety of vessels having tube necks; they also serve as shelves for the support of any vessels

during the various operations for which the apparatus is adapted. Fig. 156 illustrates this apparatus; but for a more detailed account, the reader should consult the *Proceedings*, as before mentioned.

Fig. 157 will give an idea of the arrangement of the retort and vessel for supplying the condenser with water and that for catch-

Fig. 157.



Retort stand for use in distillation.

ing the waste water upon one retort stand, which, however, must be in due proportion to the size of the condenser.

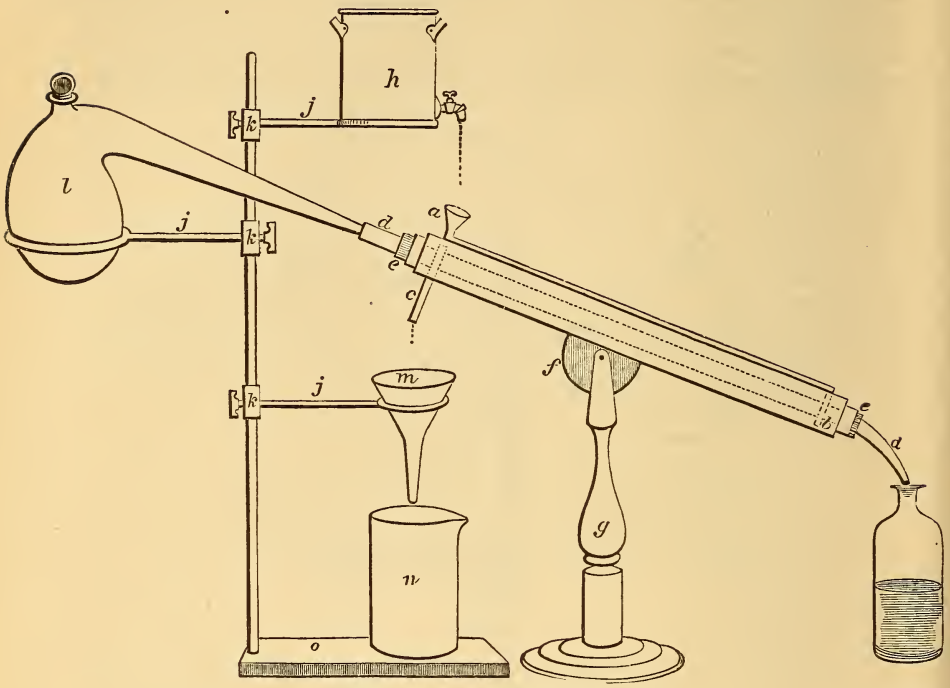
When put together, the apparatus for distillation will be complete as arranged in Fig 158. The tin bucket *h* has a small brass cock, which is so regulated in using the apparatus as to drop the water either slowly or rapidly as the warming of the water in the condenser may require.

The only use of the funnel *m* is to prevent the splashing of the water as it falls from the condenser. By placing the heavy *receiving* vessel *n* on the wooden base of the retort stand, the weight of the retort *l* is counterbalanced.

Gum-elastic tubes often become hard, and can be rendered flexible by soaking with glycerine.

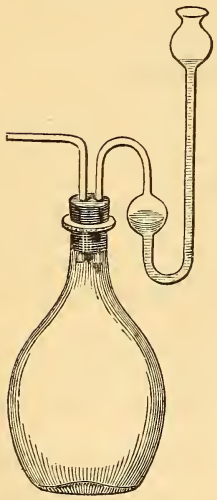
A flask with perforated cork and glass tube, as shown in Fig. 159, may be substituted for the retorts before described, an arrangement well adapted to distilling very volatile liquids, and those which boil with great violence. This figure also shows a tube for in-

Fig. 158.



Complete apparatus for distillation.

Fig. 159.



Flask and safety tube.

troducing fresh portions of the liquid without removing the cork; the tube, being bent, retains a portion of liquid in the bulb and adjacent curve, which prevents the escape of vapor from the interior. It is designed to extend only a little below the cork. In case of any stoppage in the apparatus by which an accumulation of vapor might take place in the flask or retort, this tube would serve as a safety valve, and the liquid being forced out would allow of the escape of the accumulated steam.

From the description and illustration of apparatus now given, the reader will have a good idea of the apparatus as constructed on a small scale. In using it, a volatile liquid or mixture containing a volatile ingredient being introduced into a retort or flask connected as before described, and heat applied, the volatile ingredient will rise in vapor, and, being cooled by contact with the neck of the retort, the receiver, or the glass tube of the Liebig's condenser, will be condensed, and may be collected in a liquid and pure condition.

It is a necessary precaution, in manipulating with alcoholic or ethereal liquids, as in the preparation of spirit of nitric ether, to use a water-bath for the regulation of the temperature, and for protection in case of a fracture of the retort. The use of a saturated solution of alum, which boils at 220°, and of chloride of zinc, which is available for any temperature below 320°, and of fixed oils, which boil at from 500° to 600° F., will occasionally serve good purposes in the process of distillation. In all processes the heat and refrigeration must be carefully adjusted, so that no portion of uncondensed vapor shall escape, especially if of a poisonous, corrosive, or inflammable nature.

One of the chief practical difficulties in distilling arises from the irregularity of the boiling of liquids in glass vessels, occasioning violent bumping, and sometimes the fracture of the vessel. In treating resinous substances in this way, and in the preparation of hydrocyanic acid, where a large amount of heavy precipitate is present in the liquid, this renders the operation one of great difficulty and annoyance. The best remedy for this is found in the diffusion of the heat over the whole surface of the retort in contact with the liquid, and in the interposition of angular fragments of insoluble material, such as rock crystal or broken glass, among the particles of the liquid. It is entirely prevented by a glass rod or a coil of metallic wire reaching from the bottom to the surface of the liquid, which serves to diffuse and equalize the heat. Advantage is gained by covering the bottom of the glass vessel with wire gauze, or by coating the retort with metallic silver on its inner surface. This may be done by reducing a solution of ammonio-nitrate of silver, by boiling it in the vessel to be plated, with oils of cinnamon and cloves dissolved in alcohol. Flasks may be coated on the outside with metallic copper, so as to answer an excellent purpose, by the aid of a battery.

Fractional distillation is that modification of the process by which ingredients of different volatility are separated from one another. It requires special precautions for ascertaining the temperature applied, and for changing the receiving vessel so as to collect the products volatilized at each successive boiling point as the process proceeds. A thermometer inserted into the retort or still through a cork, or a tube passing near to the bottom, will serve to indicate the variations of temperature, and a quilled receiver will be found to facilitate the collection of the successive products; when a bath is used, the temperature may be ascertained by immersing the thermometer in it.

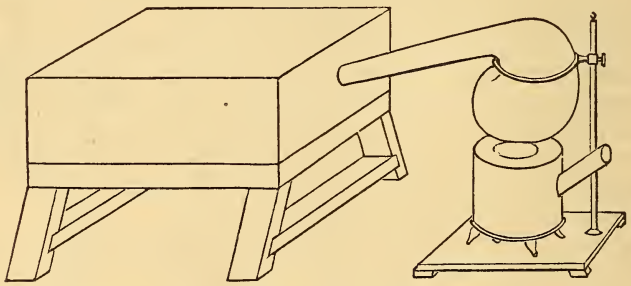
Destructive distillation is a process by which organic bodies are subjected to a gradually increased temperature, whereby the original condition is entirely broken up, the resulting products being of a less complex composition. To guard as much as possible against oxidation by the atmospheric oxygen, the operation is conducted in strong glass retorts, or, on a larger scale, in iron or earthenware retorts or cylinders. Complex organic bodies yield generally a large quantity of incondensable gases, consisting of

carbo-hydrogens of varying composition, an aqueous liquor containing formic or acetic acid, an oily liquid composed of creasote, carbolic acid, empyreumatic oils, etc., and a dark brown or black body of a honey-like consistence, like tar. If nitrogen is present in the original substance in other forms than nitric acid, it is found usually in the most volatile portions in the form of ammonia and various other ternary organic alkalies (see Syllabus of Organic Alkalies). The residue in the retort consists of carbon mixed with the inorganic bases, which are combined with mineral acids, except nitric acid, which is decomposed. In their crude state a peculiar smoky odor is attached to all the products obtained by this process, which odor is called empyreumatic.

Instances of products of dry distillation are pyroligneous acid, oil of tobacco, oil of amber, resin oil, coal oil, and illuminating gas.

Sublimation.—The dry distillation of solid substances which yield at once a solid volatile product, either pre-existing in the substance or the result of the decomposing influence of heat, is called sublimation. The apparatus consists essentially of a subliming vessel and a condensing vessel, varied by the volatility of the sublimed product. The condensing surface must invariably be out of the fire, but so adjacent that the required temperature can be maintained till the vapor reaches it. In the separation of benzoic acid from benzoin, and pyrogallic acid from galls or their aqueous extract, a shallow iron pot covered by a diaphragm of porous paper and surmounted by a cap of glazed paper constitutes a suitable apparatus; it may be heated on a sand-bath, the heat being so regulated and the diaphragm and cap so arranged that none of the vaporized acid shall escape. In the manufacture of muriate and carbonate of ammonium, and of corrosive sublimate and calomel, arrangements are required for operating on a large scale and with precautions suggested by experience, the vapor in the latter case

Fig. 160.



Apparatus for subliming camphor in pulverulent form.

being condensed in a condition of very minute division, by a current of cold air, aqueous vapor, or water. Camphor is refined or freed from impurities by sublimation into large glass balloons, which are afterwards broken; and the condensation of subliming iodine,

in order to avoid loss, is effected in a series of globular condensers connected with one another.

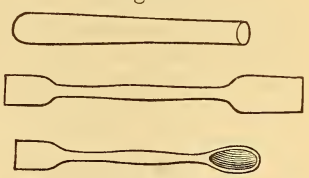
In many small operations, glass tubes closed at one end, called reduction tubes, or two flasks, one adjusted to the other and placed in such position that one may be plunged in a sand-bath below the level of the contained material while the other is cooled, may serve a good purpose.

Fig. 160 shows an apparatus for subliming camphor in fine powder for pharmaceutical uses. It is a modification of that proposed by John C. Lowd, of Boston. (*Proceedings Amer. Phar. Association*, 1871.) The retort is of copper, and the receiving vessel of tinned iron or pasteboard; the large admixture of air dilutes the vapor so that the camphor is deposited in a fine dry powder.

Dehydration and Calcination.—The application of heat to inorganic crystalline substances is sometimes with a view to the separation of water, and sometimes for the expulsion of carbonic acid or other volatile constituent. Water is present in chemical compounds either as water of hydration or of crystallization. In this form it may be regarded as a weak acid combined with a base (KO,H_2O), or as an essential constituent of certain salts, *basic* water. Water of hydration cannot, in most instances, be removed by heat, or, if expelled, the nature of the compound is altered. (See *Sodii Pyrophosphas.*)

Fig. 161 exhibits the porcelain spatulas, which are useful for stirring the mass, which first dissolves in its own water of crystallization, and afterwards dries, requiring much stirring.

Fig. 161.



Porcelain spatulas.

For dehydrating, a water-bath heat is sometimes sufficient, since water of crystallization is generally driven off at a temperature of 212° F., and a heat much above that is apt to decompose the salt; but for sulphate of iron, complete dehydration requires 300° F., and for alum 450° F. is directed; for sulphate and carbonate of sodium, which are efflorescent, a lower temperature is sufficient.

In organic substances this water may sometimes be replaced by weak acids, the weaker bases, or certain salts, and is then called constitutional water: thus, cane sugar, $C_{12}H_{18}O_9+2H_2O$, combines with oxide of lead to form $C_{12}H_{18}O_9+2PbO$.

The carbonates of the alkalies, potassa, soda, and lithia, do not lose their carbonic acid by a high heat, while those of the alkaline earths, baryta, lime, and magnesia, and of the heavier metallic oxides, are decarbonated by calcination, the former, especially, requiring a very high heat. In the processes of metallurgy, calcination is often used, not only with the view of expelling volatile products, but also for the purpose of oxidizing certain elements

present in the ores, especially sulphides. The process is then termed *roasting*.

The chief use of calcination in pharmacy is in the preparation of magnesia.

Incineration and Ignition are the same as calcination, except when applied to organic substances with a view to burning up the carbonaceous principles, converting them into carbonic acid, which remains combined with the alkali present. The free admission of air is essential for this purpose, and may be facilitated by inclining the crucible. The last portions of carbon, when consumed with difficulty, may be oxidized by the careful addition of a little nitric acid to the cold residue, and heating again to redness.

Fig. 162. Fig. 163. Fig. 164.

Porcelain, platinum, and hessian crucibles.

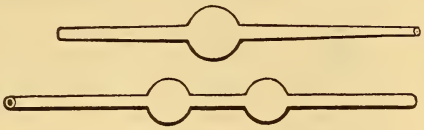
Figs. 162, 163, and 164 exhibit different kinds of crucibles used for calcination and ignition in small operations.

Torrefaction or Roasting is a process by which organic substances are changed in their qualities by the modification of some constituents without altering others. The most familiar instance of this is the roasting of coffee by which some empyreumatic principles are generated without destroying its peculiar principle, caffeina, which is itself volatile; by this process coffee, is adapted to the purposes of a beverage. Rhubarb subjected to the process of torrefaction, care being taken to have it in a suitable coarse powder, and to prevent its being carbonized, loses its cathartic properties without impairing its astringency. This is doubtless due to the volatilization of the active principle chrysophanic acid. Burnt sponge, an old remedy of great repute in scrofulous diseases, has been superseded since the introduction of iodine; in preparing it, the process is carried somewhat further than in the foregoing, and leaves little else than the porous charcoal combined with the inorganic constituents of the sponge, iodides, chlorides, etc. It furnishes an instance of *carbonization or charring*.

Reduction of Oxides, etc.—This process, so largely practised in the manufacture of iron and other metals from their ores, and in other extensive chemical operations, is useful to the pharmacist in the extraction of metallic arsenic from arsenious acid (As_2O_3), a preliminary operation to the preparation of iodide of arsenic. In this instance carbon is the reducing agent employed; by its combustion it

combines with the oxygen from the arsenious acid, and leaves the metal to be sublimed. In a small way, this process may be conducted in reduction tubes, which are shown in Fig. 165. Another

Fig. 165.



Reduction tubes.

and still more useful application of the process is that for obtaining pure metallic iron from its oxide, in which hydrogen is the reducing agent, and the resulting preparation is one of the most important of the numerous medicinal preparations of iron. The deoxidation of inorganic salts by various chemical means is also termed reduction; sesquichloride and tersulphate of iron are, by digesting their solutions with metallic iron, reduced to protochloride and protosulphate of iron. The reduction of the oxides of the so-called noble metals, silver, gold, and platinum is effected without any reducing agent, simply by the suitable application of high heat.

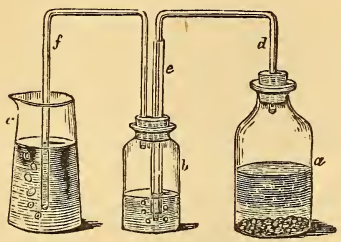
Oxidation.—This change, the reverse of the foregoing, is accomplished, in the dry way, by the combustion of substances having a strong affinity for oxygen; at a high temperature these absorb this element from the air. In the combustion of metallic zinc, it is converted into oxide of zinc (ZnO), and in the cupellation or fusion of ores of lead and silver, the semivitrified oxide of lead, litharge, is evolved. This method is not adopted in any of the familiar operations of pharmacy, but oxidation by nitric acid is resorted to in several officinal processes, as in the conversion of protosulphate into persulphate of iron, and in the preparation of red oxide of mercury. This method, founded upon the facility with which nitric acid gives up a portion of its oxygen to substances having an affinity for it, is detailed under its several appropriate heads.

Carbonic Acid Processes.—The conversion of caustic alkalies into carbonates is done by heating in contact with carbonaceous material, as in the ignition of potash to form pearlash, and in the incineration of organic matters containing alkali, before referred to. Dry carbonates may also be further charged with carbonic acid by simple exposure to an atmosphere charged with it, as in the conversion of pearlash into saleratus, and of partially dried carbonate of soda into bicarbonate. The generation of the carbonic acid gas is accomplished by decomposing either of the cheap and abundant carbonates of lime with a mineral acid; muriatic is the cheapest, and in large operations the best, from its forming a soluble residue.

Fig. 166 shows the process of generating this gas, in the bottle *a*,

washing it by passing it through water in the bottle *b*, by means of the pipe *d*, which passes through a pipe *e*, of large bore, to the bottom; and, finally, through *f*, conducting it into a solution to be charged with it. This is the process as used in the preparation of bicarbonate of potassium, the vessel *c* being filled with solution of carbonate of potassium; as the bicarbonate is formed the silica present in the carbonate, combined with the potassa, is thrown out of solution, and the bicarbonate, being in crystals, is quite pure and combined with a definite proportion of water.

Fig. 166.



Carbonic acid apparatus.

In the manufacture of carbonic acid water, incorrectly called soda water, the refrigerated water is charged with an excess of the gas, which is generated in a strong close vessel connected with the fountain by suitable pipes; in the appropriate place an apparatus for its extemporaneous preparation is figured.

In the preparation of *chlorine water*, the oxidation of substances by the use of nitric acid, and the generation of hydrosulphuric acid, special precautions are necessary to prevent the too rapid evolution of the noxious gases and their diffusion in the atmosphere. A chimney flue furnishes the means of carrying these off, and in the construction of a furnace as before described ample facilities may be secured.

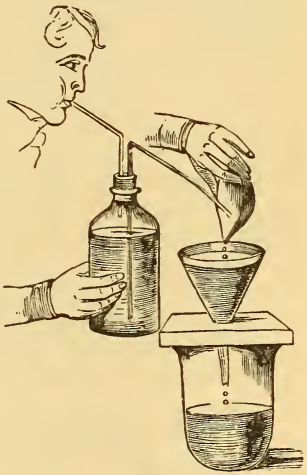
The *mode of saturating water* either with chlorine or hydrosulphuric acid was formerly by the use of a series of Woolf's bottles, figured in works on chemical manipulation. The preparation of these involves so much trouble and delay as to operate as a discouragement to the preparation of the solutions. An extemporaneous process found quite successful is to pass the conducting tube from the wash bottle, or the flask in which they are prepared, into a pretty large narrow-mouthed bottle about one-third full of water, having another at hand to substitute for it as this becomes filled with gas; these may be dexterously shifted so as to be alternately filled and shaken a few times with the heavy gas, by which means it will be more effectually brought into contact with and dissolved by the water than it can be by bubbling through a still solution for a long time.

Decoloration, viewed as a process of pharmacy, is mainly accomplished by digesting the substance in solution with charcoal in a granular condition. The utility of this decolorizer is in proportion to its porosity, and hence animal charcoal, which contains bone phosphate of lime insinuated among its pores in the process of its formation, furnishes a very superior decolorizer. The same property which fits the charcoal for this use causes it to absorb

other constituents of solutions, so that, unless the precaution is taken to percolate the charcoal thoroughly with fresh portions of some solvent, a portion of the most desirable constituents may be lost. In forming solutions of resins, as that of jalap, Professor Procter recommends that their powders should be mixed with an equal bulk of charcoal, introduced into a percolator on top of a layer of charcoal, and then treated with alcohol until the resin is dissolved out. In the preparation of the vegetable alkalies, animal charcoal is almost invariably employed to decolorize the product previous to its final crystallization.

Washing of Chemical Substances.—In order to remove adhering impurities, freshly precipitated powders or recent crystals are frequently subjected to the process of washing. This is sometimes accomplished on a plain filter, Fig. 167, by the aid of a *spritz*, which, besides aiding the removal of the solid material on to the filter, is well adapted to directing a strong thin current of water or other liquid upon the contents of the filter. The concave surface naturally assumed by the contents of a filter is the most favorable to an equal diffusion of the liquid through its mass. The spritz may be constructed by inserting a single tube with a capillary orifice through a cork into a bottle. The bottle being partly filled with water, the contained air is compressed by blowing into it, so that when the bottle is quickly inverted it forces out the water through the orifice in a jet. The kind shown in use in the drawing is more complete in its operation; it has two tubes, one dipping below the surface of the liquid, bent to an acute angle and drawn out to a small orifice; the other, designed for blowing into the upper part of the bottle, so as by compressing the air to induce a stream from the orifice. If a flask is substituted for the bottle, the liquid may be heated over a lamp or sand-bath, and the washing accomplished by boiling water or alcohol.

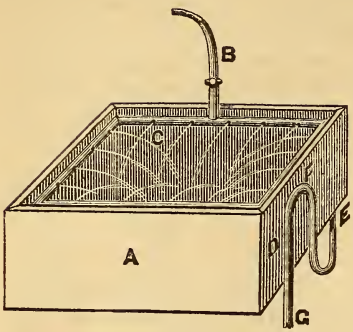
Fig. 167.



Spritz bottle and its use.

Fig. 168 shows an ingenious apparatus, invented by my friend C. Wager Hull, of New York, for washing photographic prints, but also applicable to any washing process requiring a repeated and entire change of water. Being entirely self-acting, it requires no care or attention. It consists of *A*, a water-tight box of any shape; *B*, a feed-pipe with a faucet; *C*, a lead pipe around the inside, perforated with small brad-awl holes, through which the water is evenly sprinkled upon the articles to be washed. For paper photographs the awl holes should be made at an angle so that the jets will be in the

Fig. 168.



Hull's automatic washing-box.

same direction, and thus cause a constant current to float the paper around the box. A tray of wire or a network of twine or any suitable perforated diaphragm may be placed above and near the bottom of the box to receive the articles. A siphon enters the box through a hole in the bottom, having a broad flange of lead which is nailed to the bottom, and then passes down sufficiently to make a suitable curve to the point *F*, which should be one or two inches below the top of the box; here it curves again to *G*, or any point below the line of the bottom of the box. The longer the leg *D* of the siphon, the faster will the liquid flow; it is generally connected with a waste pipe carrying off the washings into the sewer, and the feed pipe may be connected with the street mains or with any suitable reservoir above the box. The successful action of the apparatus depends upon the relative size of the feed pipe and siphon; the former should be smaller than the latter; then as soon as the box is filled by the action of the sprinklers up to the top of the siphon at *F*, the discharge will begin and go on rapidly till the entire liquid contents have run out; then the siphon will cease to act till the box fills up again, when it will be discharged in the same way. The superiority of this over ordinary tubs for the purpose consists in its completely emptying itself at intervals, so that every fresh charge of the liquid is pure and free from contamination with previous charges, a point of great importance in washing photographic prints.

The subjects of *filtration* and *decantation* will be so fully presented under the head of Solutions, in the fifth part of this work, that they need claim no further notice in this connection.

Precipitation.—The term precipitation refers to the separation of a solid substance, whether in crystal, in powder, or in a moist, tenacious mass, called a magma; whether it falls to the bottom, floats in flocculæ, collects near the surface, or remains diffused throughout the liquid.

This separation is brought about by a chemical or other change affecting solubility, and the substance added to produce it is called the precipitant; the solid substance produced, the precipitate. Precipitation is frequently produced by the play of affinities, affording an insoluble substance from elements which, as previously combined, constituted soluble compounds; for, where solutions of chloride of sodium and of nitrate of silver are added to each other, chloride of silver and nitrate of sodium are produced, the former an insoluble salt, and hence precipitated.

Whenever two or more chemical substances in solution are mixed, if the elements of an insoluble compound are present, that insoluble compound will be precipitated.

Another cause of precipitation is any change in a liquid by which it ceases to be a solvent for the particular substance in solution. Substances soluble in alcohol, such as iodine, camphor, and the resins, on the addition of water, are precipitated, because the alcohol forms with water a liquid in which they are insoluble.

With a view to collecting precipitates deep vessels should be employed, preferably larger at the bottom, as in the drawing; they favor the ready decantation of the liquid.

Fig. 169.

Precipitating jar.

The strength of the solutions mixed determines the density of the precipitate, and hence, in cases where this quality is desirable in the product, and where it is an object to collect the precipitate in small bulk with reference to its convenient washing, the solutions are made correspondingly strong. Hot solutions should be used in preference to cold, with a view to the same object, and also, in the case of iodide of lead and biniodide of mercury, which are soluble in the hot liquid, to produce handsome and well-defined crystals on cooling.

Crystallization.—The most characteristic physical phenomena of chemical substances are those mathematical forms which they spontaneously assume in passing from the liquid or gaseous to a solid condition, and the crystalline form is the purest attainable of chemical substances.

Crystals are formed from some volatile substances by the process of sublimation, already referred to; by fusion, in a few instances, such as sulphur, some of the metals, and a few anhydrous salts; but more generally on the cooling or gradual evaporation of a solvent, or by the production of a less soluble crystalline substance by some chemical change in a solution. The vessels best adapted to crystallization are rather shallow evaporating dishes, or, for large operations, wooden or earthenware crystallizers. A hot saturated solution being filtered into the vessel for crystallization is to be set away in a suitable place, and should not then be disturbed till the liquid has become cool or has been nearly all evaporated. The last portion of the liquid poured off from the crystals is called the mother-liquor, and contains the residuary and most soluble portions in concentrated solution, with the less crystallizable impurities. In manipulating with costly materials, the mother-liquor is retained for admixture with other lots, or subjected to further evaporation to obtain another crop of crystals. The size and transparency of crystals are most influenced by the slowness and uniformity of their deposition, the clearness and purity of the filtered solutions, and their proper strength. When a solution is evaporated to a very concentrated condition, shown by the formation of a pellicle or crust upon its surface, it generally throws down a confused crystalline

mass, but when set aside before it has quite reached its point of saturation, the gradual evaporation insures a slow formation of large and more perfect crystals. The circumstances which promote perfect crystallization are thus the reverse of those by which the finest and most dense powders are obtained, and, as a general rule, those substances most desirable to obtain in the form of powder are not those which form elegant crystals.

Some chemical substances, much used in solution, are preferably made in small, imperfectly formed crystals; sulphate of zinc and sulphate of magnesia are familiar instances of this. Some, which are crystallizable with great difficulty, are collected from their clear solutions by *granulation*, a process accomplished by constantly stirring the evaporating solution from the time it begins to thicken till the water is entirely driven off. Carbonate and citrate of potassium are familiar instances of this; in the case of the latter salt, the heat must be carefully managed or the product may be burned. (*See* Powders.)

CHAPTER II.

CHEMICAL PROCESSES ON THE NON-METALLIC ELEMENTS AND THEIR MEDICINAL PREPARATIONS.

The distinction usually recognized by chemists between the non-metallic elements and metals, though arbitrary, is yet well understood and convenient, and will furnish the basis for the division adopted in the present work. Of the thirteen non-metallic elements, nearly all enter into medicinal preparations, but only the six following will require notice in the present chapter—in the following order:—

Oxygen, O, 16	Iodine, I, 127	Phosphorus, P, 31
Chlorine, Cl, 35.5	Bromine, Br, 80	Sulphur, S, 32

Compounds containing *carbon* constitute the larger number of organic chemicals treated of in Part IV., while carbonic acid and its aqueous solution are appropriately considered in the chapter on the mineral acids. The same applies to *boron*, which forms an oxyacid, and *hydrogen*, which is chiefly useful in the inorganic kingdom in water in its well-known acid combination with chlorine; while *nitrogen* enters into one of the most important of the series of acids, and into the equally important alkali, ammonia.

Oxygen. O (+ O) = 16.

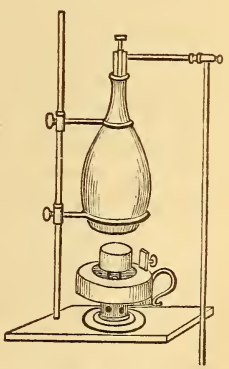
In a state of combination oxygen is the most extensively diffused body in nature, forming one-fifth part of the atmosphere, entering as a constituent into water, into nearly all the mineral substances composing the crust of the earth, and into most organic products.

With other elements oxygen unites to form anhydrous *acids*, as formerly denominated, though called by modern chemists anhydrides, as carbonic, CO_2, sulphurous, SO_2, and phosphoric acid, P_2O_5, which, with water, form the well-known acids so much used in chemistry and pharmacy. Some of the compounds of oxygen are *neutral* substances, such as water, H_2O, carbonic oxide, CO, and nitrous oxide, N_2O, the first named of which is of great chemical interest in connection with the study of salts. The *bases*, of so much interest, were formerly regarded as compounds of the metals with proportions of oxygen; but the term is not used by modern writers, who regard the salts as direct compounds of the metals with the respective acids—a view so far adopted in the *U. S. Pharmacopœia* as to be recognized in the nomenclature of the last edition. The direct combination of oxygen with other bodies is attended with the evolution of heat, and sometimes light, which occasions the process of oxidation to be much resorted to for the production of heat and light without reference to the compounds produced. Where a body combines rapidly with oxygen, it is said to be burned, and the process of rapid oxidation is called combustion.

Although oxygen is not used in medicine, except for inhalation as an antidote to carbonic oxide or carbonic acid gas, it is an element of great interest not only to the physician and pharmacist, but to persons in every department of life.

Oxygen is prepared by heating binoxide of manganese in an iron retort, or more readily, on a small scale, by heating chlorate of potassium in a retort of hard glass or a Florence flask. This salt contains potassium combined with chloric acid, K,ClO_3, and yields the whole of its oxygen (39.2 per cent.) by heating, chloride of potassium remaining as a residue; thus, $KClO_3 = KCl$ and $3O$. The tubule of the retort, or, if a flask is employed, a bent tube of glass secured to it by a cork is carried into a bell glass or other receiver filled with water and inverted in a vessel of water; the gas gradually displaces the water occupying the vessel, which may be removed and replaced by another until the whole is collected; half an ounce of chlorate yields 270 cubic inches, or nearly a gallon, of oxygen. The chief inconvenience in this process arises from the liability to softening of the glass of the retort or to its fracture by the intense heat required; this may be partially obviated by mixing two parts of the powdered chlorate with one of the binoxide of magnesia, MnO_2, previously well dried, and by subjecting this to a somewhat less intense heat the gas will be obtained. The best form of apparatus for obtaining oxygen is shown in Fig. 170. It consists of a copper flask, and a tube bent at right angles, secured by a gallows screw to the head of the flask; the lower end of the tube is carried below water, and the gas as it rises is caught in appropriate bell glasses.

Fig. 170.



Oxygen apparatus.

To collect this gas for inhalation it should be passed into a tubulated bell jar, over the tubule of which a collapsed and softened bladder, or, preferably, a bag of gum-elastic, has been secured. By submerging the jar the gas ascends into the bag, and it may then be secured and administered by a breathing tube.

In cases where, from the stoppage of flues or deficient ventilation in chambers, individuals are subjected to the inhalation of noxious products of combustion, carbonic acid and carbonic oxide gases, producing more or less complete narcotism, sometimes resulting in death, oxygen gas, administered by the lungs before respiration has ceased, or by means of artificial or induced respiration, is found to be a most valuable antidote.

Ozone and Antozone.

This allotropic condition of oxygen, discovered by Schönbein, seems likely to produce remarkable changes in the generally received opinions in regard to numerous phenomena, both natural and artificial. It was first recognized by a peculiar odor accompanying discharges of electricity, especially when silently emitted, and has since been obtained by a variety of processes, among which the following are the most important: Into a large salt-mouth bottle of air place a stick of phosphorus, recently scraped; cover it partially with water, introduce the stopper, and set it away in a room at a temperature of from 60° to 70°. In the process of oxidizing the exposed phosphorus, a portion of the oxygen passes into the condition of ozone and antozone, which are diffused in the air, though never in large proportion; if long kept, these are lost by combining with and oxidizing the phosphorus; by washing and decantation, the ozonized air may be deprived of the vapor of phosphorus, and preserved. Ozone is also a product of the slow combustion of ether; if a small quantity of ether is placed in a bottle and a rod of iron or glass heated to just 500° is introduced, the atmosphere of the jar will acquire the properties of ozone, while the ether possesses the characteristics of *antozone*. As a more permanent source of ozone, Boettger has recommended the opaque olive-green mixture of two parts of permanganate of potassa with three parts of strong sulphuric acid; subjected to the atmospheric oxygen it continues for a long time to give out ozone. As obtained by these processes it is always largely diluted with air; certain liquids, however, have a strong affinity for it; of these, oil of turpentine, oil of cinnamon, oil of lemon, and flaxseed oil, either possess the power of inducing its formation, or, by their solvent power, become reservoirs of it. How far its presence may account for those changes of properties of oil of lemon, camphene, and other carbo-hydrogens, which are so well known but so ill explained, is worthy of investigation. Oils of cinnamon and of turpentine when charged with it exhibit bleaching properties.

Ozone is readily absorbed by solution of an alkaline iodide, converting it into iodate; it oxidizes moistened silver leaf and thin

strips of arsenic, and antimony in the cold. From the metallic iodides it liberates iodine; oxidizes protosalts of lead and manganese to peroxides; converts sulphides into sulphates, and ferrocyanides into ferridcyanides. Taken into the lungs it produces catarrh and contraction of the chest; it destroys organic coloring matter with the greatest energy; bleaches blue litmus without first reddening it; discharges the color of sulphate of indigo by contact alone; turns paper, impregnated with aniline or pyrogallic acid, to brown; renders cork and caoutchouc brittle and destroys them; decomposes tannic acid, oxalic acid being a product.

These changes are all due to oxidation, and oxides are the result. The following are the usual *tests* for ozone: *Schönbein's* test is made by dissolving one part of pure iodide of potassium (free from iodate) in two hundred parts of pure water, then adding ten parts of starch, in fine powder, and gently heating till the starch is dissolved. White paper is soaked in this liquid, then dried and cut into strips, which are to be preserved in stoppered bottles. This paper, exposed to the air in a spot sheltered as much as possible from rain, light, and foul effluvia for a period of from six to twenty-four hours, will show the presence of ozone in the atmosphere by changing to brown, and when wetted, from a pink to blue color, according to the proportion of ozone in the air. Paper soaked in an alcoholic solution of guaiacum and dried in the dark acquires a bright blue color by contact with ozone.

The presence of this active form of oxygen in the atmosphere is deemed of importance in the study of those mysterious influences connected with the cause of malarious and contagious diseases, but the subject has not yet been sufficiently studied. The most remarkable properties of ozone appear to grow out of its peculiar relations to oxygen, from which it is produced by electricity, while by a heat of 450° to 600° it is always convertible into oxygen. Certain well-known disinfectants and bleaching agents are now found to owe their properties to this constituent; this is especially the case with the alkaline permanganates, and the solution of permanganate of potassium has been introduced under the name of *ozonized water* as a deodorizer in medical practice. Magnetic oxide of iron is also said to contain oxygen in the state of ozone, and a filter is in use in England in which this mineral is the active material for the purification of water by oxidizing and destroying all organic matters contained in it. The principal oxides in which the oxygen appears to exist as ozone, called by Schönbein *ozonides*, are as follows: Mn_2O_7, MnO_2, MnO_3, PbO_2, AgO_2, CrO_3, BiO_5, Ni_2O_3, CO_2O_3, among which peroxide of lead (PbO_2) appears to have the most energetic action, displaying some of the characteristic reactions of ozone without the addition of any acid to decompose it.

Antozone has been less studied than ozone. It appears to be produced whenever ozone is formed either by electrical action or oxidation. Some chemists believe ordinary oxygen to be a compound of ozone and antozone. Of the methods for preparing antozone, the following will suffice: a little concentrated sulphuric acid is poured

into a small bottle, and into this are thrown some fragments of pure peroxide of barium BaO_2; when gas is liberated, the air of the bottle will be found to be charged with antozone. Sometimes it is necessary to introduce the bottle into a moderately warmed water-bath; at other times the reaction is required to be allayed by applying cold water. Antozone is a gas with odor somewhat resembling ozone, though different and more disagreeable; it is less permanent than ozone, being very readily converted into ordinary oxygen.

If air charged with antozone is made to bubble through water, it will raise as it ascends a thick white mist or cloud, which may be collected and poured from one vessel to another, and is deposited as drops of water only when the antozone has become converted into ordinary oxygen, or entered into combination. It is through the existence of antozone, that water may be oxidized into peroxide of hydrogen, H_2O_2, an object of scientific interest not utilized either in medicine or the arts.

Chlorinium. Cl = 35.5. (Chlorine.)

Chlorine is a dense, suffocating, corrosive gas, 2.5 times as heavy as atmospheric air, and of a pale yellowish-green color. Under the pressure of about four atmospheres it condenses into a yellow liquid, sp. gr. 1.33. It is one of the most active of chemical agents, entering into combination with nearly all the other elements, especially with the metals, but not existing in nature uncombined. The chlorides are remarkable for solubility, and consequently find a place among the constituents of sea water, common salt, NaCl, being obtained in large proportion from that great reservoir.

The chief use of uncombined chlorine is as a disinfectant and a bleaching agent, both of which properties it appears to owe to its relation with hydrogen. In contact with most organic substances it decomposes them, eliminates a portion of their hydrogen as hydrochloric acid, and enters also into compounds by substitution for the hydrogen in their composition.

To the physician and pharmacist chlorine is most interesting in the form best adapted to liberate it into the atmosphere for its uses as a disinfectant. The reader is referred to the chapter on the alkalies and alkaline earths for its loose combinations with lime and soda; in this place it will suffice to notice the chlorine mixture especially adapted to hospitals, and the Aqua Chlorinii of the Pharmacopœia.

Chlorine Disinfecting Preparation.

This consists of packages of a dry powder and a bottle of diluted sulphuric acid, put up together for extemporaneous admixture, as follows:—

The Common Salt Mixture.

Take of Common salt, well dried	1800 parts.
Binoxide of manganese, containing 72 per cent .	1875 parts.

Grind them together into a fine powder, and put up the powder in packages containing about 195 grains each, and put 130 of these

packages in a pasteboard box to accompany the sulphuric acid mixture.

Each of these packages requires half a fluidounce of the sulphuric acid mixture, and yields about 57 cubic inches of chlorine. This quantity, when thus liberated gradually in a space containing about 20,000 times its volume of air, is borne without inconvenience by persons generally, and is not injurious even in pulmonary diseases. It should never be used in such quantities as to produce discomfort or bronchial irritation.

The Sulphuric Acid Mixture.

Take of Sulphuric acid, sp. gr. 1.845 . . . . . 45 parts.
Water . . . . . 21 parts.

Mix them carefully, and when cold put the mixture into strong bottles, with accurately ground stoppers, each bottle to contain sixty-five fluidounces.

Half a fluidounce of this to be used for each package of the common salt mixture.

Directions for Use.—One package of the common salt mixture, placed in a saucer or plate and thoroughly mixed with half a fluidounce of the sulphuric acid mixture, is to be placed under every alternate bed at night and allowed to remain there three days. Upon the second night, the beds which were omitted should be supplied in the same way and for the same length of time, and the process repeated at the end of three days, or sooner, according to circumstances. Should the wards be badly ventilated, or contain many sloughing wounds, or be subject to epidemic disease or low forms of fever, the mixtures should be renewed every third day. Otherwise once a month may be sufficient; and, when thorough cleanliness and ventilation are attained, the process is unnecessary for occupied wards. In disinfecting unoccupied wards, water-closets, latrines, etc. by chlorine, they should be cleansed, closed up as perfectly as practicable, and two packages used for each 600 cubic feet of space.

The *rationale* of the liberation of chlorine from the mixed chloride of sodium and binoxide of manganese, on the addition of sulphuric acid, may be thus expressed: $2NaCl + 2H_2SO_4 + MnO_2 = Na_2SO_4 + MnSO_4 + 2H_2O + Cl$.

Aqua Chlorinii. (*Chlorine Water.*) U. S. P.
Liquor Chlori. (*Solution of Chlorine.*) Ph. Br.

Take of Black oxide of manganese, in fine powder, half a troyounce.
Muriatic acid, three troyounces.
Water, four fluidounces.
Distilled water, twenty fluidounces.

Introduce the oxide into a flask, add the acid previously diluted with two fluidounces of the water, and apply a gentle heat. Conduct the generated chlorine, by suitable tubes, through the remainder of the water contained in a small intermediate vessel, to

the bottom of a four-pint bottle containing the distilled water and loosely stopped with cotton. When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, agitate the contents, loosen the stopper from time to time, until the gas ceases to be absorbed. Lastly, pour the chlorine water into a bottle, of just sufficient capacity to hold it, stop it securely, and keep it in a cool place, protected from the light.

Black oxide of manganese is used in this process because of its facility for yielding oxygen under the circumstances to hydrogen of the muriatic acid to form water, while the chlorine of the acid unites in part with the manganese, and is in part set free; the reaction which occurs is thus formulated: $MnO_2 + 4HCl = 2H_2O + MnCl_2 + 2Cl$. Great care should be taken in liberating and manipulating with chlorine to avoid inhaling it; when taken into the lungs, unless very largely diluted with air, it is extremely corrosive.

This process requires the adjustment of flask and tubes, as figured on page 124. The great solubility of chlorine in water forbids the use of more than a limited quantity in the intermediate (wash) bottle; this is designed to absorb any portion of the undecomposed muriatic acid which may pass from the flask. The size of the receiving bottle is important as determining the quantity of chlorine in the resulting preparation. This mode of receiving and dissolving the gas is considered an improvement on the Wolff's bottles formerly in use; about three pints of chlorine are by this arrangement conveniently collected and dissolved in the twenty fluidounces of water prescribed. With a view to warming the flask and not the receiving bottle, the connecting glass tube should be ten or twelve inches long, and should have one or more joints of gum-elastic tube.

Chlorine water is a yellowish-green fluid, smelling strongly of chlorine. It is used chiefly as an antiseptic and stimulant to the liver, applied externally and internally. The dose is from one to two fluidrachms, largely diluted. This preparation furnishes a good means of liberating the gas for inhalation, or for diffusion as a disinfectant. When a fluidounce of it is mixed with a solution of ten grains of pure sulphate of protoxide of iron in two fluidrachms of water, the mixture does not produce a blue precipitate with ferridcyanide of potassium (red prussiate of potassium). (See *Vapor Chlori.*)

Iodine and its Preparations.*

Iodinium, I. Solid crystalline scales, sp. gr. 4.95.
Potassii iodidum, KI. In cubical crystals. Dose, gr. ij to gr. v.
Sodii iodidum, NaI. Cubical crystals. Dose, gr. ij to v.
Ammonii iodidum, NH_4I. Very deliquescent. Dose, gr. v to x.
Calcii iodidum.
Tinctura iodinii. ʒss to fʒj alcohol, externally used.
" iodinii composita, I, gr. xv, KI, ʒss to fʒj. ♏ xv to xxx.
Liquor iodinii compositus, I, gr. xxijss, KI, gr. xlv to fʒj. ♏ x to xx.

* Most of the iodine salts are described under the several heads of their metallic bases.

Iodinium. I = 127. (*Iodine.*) U. S. P.
Iodum. (*Iodine.*) Ph. Br.

This non-metallic element, existing in sea-water and marine plants, is procured for use in medicine from the fused and vitrified ashes of sea-weed called kelp, which is prepared in the Western Islands, North of Scotland and Ireland, and on the coast of France, at Cherbourg, and at LeConquet, near Brest. According to the report on the medical and pharmaceutical products at the Great Exhibition of 1862, Tissier & Son, of the latter place, produced of iodine and iodide of potassium, each, from 8000 to 10,000 lbs., bromine, 1500 to 1800 lbs., and bromide of potassium, 1100 to 1300 lbs. annually. The process of preparation is briefly as follows:—

The kelp, being broken and lixiviated, yields about half its weight of soluble sodium, potassium, and magnesium salts. The common salt, and carbonate and sulphate of sodium, and chloride of potassium are crystallized out on evaporation. The mother-liquor contains iodides of sodium, potassium, and magnesium, to which sulphuric acid is added, liberating carbonic acid, sulphuretted hydrogen, and sulphurous acid, by effervescence, and sulphur which is deposited. The acid lye is next distilled from peroxide of manganese, which liberates the iodine, and it is condensed in cooled glass receivers. This process, as applied to iodide of sodium, is explained by the following formula: $2NaI + 2HSO_4 + MnO_2 = Na_2SO_4 + MnSO_4 + 2H_2O + 2I$.

Iodine is in bluish-black crystalline scales with a metallic lustre, sp. gr. 4.948, fusing at 225°, boiling at 347°, and evaporating at ordinary temperature, especially when damp. It melts when heated. its vapor is of a splendid violet color, odor like chlorine, and sublimes in very heavy violet vapors. Free iodine precipitates starch in the cold, of a dark blue color, which reaction is its most familiar and delicate test. Water dissolves about $\frac{1}{7000}$th of its weight of iodine, being slightly discolored by it, but, on the addition of either of the alkaline iodides, or of chloride of sodium, it becomes extremely soluble; it is also very soluble in alcohol and ether. It dissolves in alkaline solutions, forming iodides and iodates. With the metals and most of the non-metallic elements, it combines with avidity, and several of its combinations are officinal; of these, the iodides of mercury, of lead, zinc, cadmium, iron, arsenic, and sulphur are considered under the head of their metallic elements, while the several preparations which owe their value exclusively to iodine are introduced here.

Locally applied, iodine is an irritant and vesicant, staining the skin brown or orange color, causing itching, redness, and desquamation. This discoloration of the skin may be best removed by ammonia or by hyposulphite of soda. Applied by inunction, it is absorbed, producing its characteristic stimulating effect; inhaled as vapor in a very diluted form, vapor iodi, it exercises its alterative effect on the mucous membrane of the respiratory passages. Its influence is chiefly exerted on the glandular and absorbent systems.

The element itself and its salts are used both internally and topically for an immense number of diseases requiring alterative treatment; when given internally, it is always in solution or combination. (*See* Solution and Tinctures, page 138.)

Potassii Iodidum. KI = 165.5. *Iodide of Potassium.* U. S. P. (*Hydriodate of Potassa.*)

Potassii Iodium. Iodide of Potassium. Ph. Br.

This salt was formerly directed to be made by combining iodine with iron, and decomposing the iodide of iron with carbonate of potassium, precipitating the carbonate of iron, filtering, and crystallizing. A modification of this process is to combine 400 parts of iodine with 508 of bicarbonate of potassium and sufficient water, and then add 112 parts iron filings in divided portions; boil, filter, evaporate, and granulate the iodide. This process, which is, in some respects, the most convenient to the pharmacist, is not adopted in the United States or British Pharmacopœia, where the plan is prescribed of adding iodine simply to a solution of caustic potash, thus forming the mixed iodide of potassium and iodate of potassium ($6KHO + 3I_2 = 5KI, + KIO_3 + 3H_2O$). This being heated to redness in contact with charcoal, the iodic acid, IO_3, parts with its oxygen, and the iodate, KIO_3, is reduced to iodide of potassium, KI. The process of Liebig, as modified by W. Stevens Squire, of London, consists of treating the iodine with a small proportion of phosphorus in water, thus converting it into hydriodic acid, which is then mixed with lime, and the iodide of calcium formed is first fused and then decomposed by sulphate of potassium into sulphate of lime, which is precipitated, and iodide of potassium, which remains in solution, is collected and crystallized. (See *Amer. Journ. Pharm.*, vol. xxxiv. p. 437.)

This salt is in white, shining, semi-opaque cubes, with a characteristic marine odor, an acrid saline taste, resembling common salt; soluble in two-thirds its weight of cold water, and freely in alcohol. Either chlorine, ozone, or nitric acid decomposes its solution, yielding iodine, and if starch be subsequently added, the characteristic blue iodide of amylum is produced.

Tartaric and other acids do not liberate iodine immediately, but the acid compound, hydriodic acid (HI); hence the old name of the salt, hydriodate of potassa.

Iodide of potassium is liable to adulteration with bicarbonate or carbonate of potassium; the latter renders it very damp, and they both occasion effervescence with acids, and throw down a precipitate with sulphate of iron. Chloride of platinum should color its solutions reddish-brown, without causing a precipitate. The presence of a chloride may be determined by nitrate of silver, which throws down nothing from the pure salt but iodide of silver, which is almost insoluble in ammonia, while chloride of silver is readily soluble in it. The iodide of silver, precipitated from 10 grains of iodide of potassium, weighs, when washed and dried, 14.1 grains. When acetate

or nitrate of lead is added to iodide of potassium, it throws down a yellow iodide of lead, soluble in boiling water. Bromide may be detected by adding nitric acid, and observing the vapors that arise; those of bromine are red; those of iodine purple. Sometimes iodate of potassa is present, which may be detected by tartaric acid liberating iodine, perceptible by the starch test.

This salt contains no water of crystallization. Every four grains contain about three grains of iodine. The aqueous solution is capable of taking up a large quantity of iodine, forming a liquid of a deep brown color.

Iodide of potassium is considered to possess the same medicinal virtues as iodine, though preferred by some physicians to obtain the constitutional effects of the alterative. It is used very extensively, both alone and combined with iodine, and with other alterative remedies; it is incompatible with the preparations of mercury generally, greatly increasing their activity. Dose, gr. ij to gr. v.

Iodide of Calcium. CaI = 147.

This is prepared, according to Malme, by treating a solution of iodide of iron with milk of lime, filtering, and evaporating. The liquid thus treated yields crystals of iodide of calcium. Although recommended as preferable to any other iodide in phthisis, it does not seem to have been much employed. The dose is from one to four grains after each meal.

Iodide of Sodium. NaI = 149.6.

Sodii Iodidum.—This salt may be prepared from a freshly-prepared solution of iodide of iron or zinc, by precipitating it with pure carbonate of sodium, or by modifications of the processes mentioned under the head of iodide of potassium, evaporating and allowing it to crystallize at a temperature exceeding 120° F., or it may be evaporated to dryness and granulated. Below the temperature named, it crystallizes with four equivalents of water in deliquescent, flat, hexagonal prisms; crystallized as above, it forms cubes which contain no water, and are very soluble in water and also in alcohol.

It has been used as a substitute for iodide of potassium; its advantage over the potassium salt consists in its having 85 per cent., while the other has only 76 per cent., of iodine in combination.

Ammonii Iodidum, U. S. P. $NH_4I = 144$. (*Iodide of Ammonium.*)

Take of Iodide of potassium, in coarse powder, four troyounces.
Sulphate of ammonium, in coarse powder, a troyounce.
Boiling distilled water, two fluidounces.
Alcohol, water, each a sufficient quantity.

Mix the salts, add them to the boiling water, stir well, and allow the mixture to cool; then add a fluidounce of alcohol, mix well, and reduce the temperature by a bath of ice-water to about 40°; throw the mixture into a cooled glass funnel stopped with moist-

ened cotton, and when the clear solution has passed, pour upon the salt a fluidounce of a mixture of two parts of water and one of alcohol. Lastly, evaporate the solution rapidly to dryness, stirring constantly, and preserve the residue in a well-stopped bottle.

It crystallizes in cubes, and is very deliquescent. It has been used as a substitute for iodide of potassium on account of the looseness with which the iodine is combined. It is one of the most useful of chemical agents in the hands of the photographer.

Internally it has been prescribed in doses as high as 10 grains; externally in ointments of from ϑj to ʒj to an ounce of lard.

Tinctura Iodinii, U. S. P. (*Simple Tincture of Iodine.*)

	To make Oj.	To make fʒj.
Take of Iodine	ʒj.	ʒss.
Alcohol	Oj.	fʒj.

Dissolve the iodine in the alcohol. This may be done either by triturating it with successive portions of alcohol in a glass or porcelain mortar, or by circulatory displacement; the iodine should be put into a syringe tube, the lower end of the tube dipping below the surface of the alcohol; as the iodine dissolves, the fresh portions of alcohol rise, and continue the process till it is completed. This tincture contains one grain in 16 minims, or about 35 drops; it is not adapted to internal use, as, on the addition of water, the iodine is precipitated, and exercises its peculiar irritating topical effect on the coats of the stomach. This precipitation is partially obviated by the gradual formation of the hydriodic acid, where there is water present; but the use of *strong* alcohol as the solvent is said to prevent the formation of this acid. Tincture iodi, Ph. Br., contains iodine ½ oz. av., iodide potassium ¼ oz. av., rectified spirit 1 pint imp. It is much weaker than that of the U. S. Pharmacopœia, and more nearly resembles the compound tincture. Tincture of iodine is applied to the skin as a powerful irritant in cutaneous and subcutaneous inflammation. In treating erysipelas, and when the surface to be treated is circumscribed, it is applied with a camel-hair brush.

Tinctura Iodinii Composita, U. S. P. (*Compound Tincture of Iodine.*)

	To make Oj.	To make fʒj.
Take of Iodine	ʒss	gr. xv.
Iodide of potassium	ʒj	ʒss.
Alcohol	Oj	fʒj.

Dissolve the iodine and iodide of potassium in the alcohol.

This is adapted to the same use as the foregoing; by the presence of the iodide of potassium, the precipitation of iodine on contact with aqueous liquids is prevented. It is weaker than Lugol's solution, and may be used internally in doses of ɱxv to xxx.

These tinctures are included under the general head *Tincturæ*, U. S. P., while the following is placed under the head *Liquores:*—

Liquor Iodinii Compositus, U. S. P. (*Lugol's Solution.*)

	To make Oj.	To make f℥j.
Take of Iodine	℥vj	gr. xxijss.
Iodide of potassium	℥iss	gr. xlv.
Distilled water	Oj	f℥j.

Lugol's solution, as originally proposed, contained twenty grains of iodine, and forty of iodide of potassium, to f℥j of water; the present officinal preparation is adjusted to the proportions convenient for a pint, and, as is seen above, is somewhat stronger. The liquor iodi, Ph. Br., contains iodine twenty grains, iodide potassium thirty grains to the fluidounce. Dose, ♏x to xx.

In iodine and compound iodine ointments, U. S. P., we have nearly the same proportions as in the tinctures, substituting lard for alcohol and water. (*See* Extemporaneous Preparations.)

Soluble Iodide of Starch.

Take of Iodine	12 parts.
Starch	100 parts.
Ether	20 parts.

Dissolve the iodine in the ether, pour the solution over the starch, triturate till the ether is evaporated; introduce into a water-bath, and continue the heat for half an hour with occasional stirring. A portion of the iodine vapor has escaped, but the starch which has now become soluble will be combined with about 4 per cent. of iodine.

Syrup of Iodide of Starch.

Take of Iodide of starch	25 parts.
Water	345 parts.
Sugar	635 parts.

Dissolve the iodide in the water, and add the sugar.

This syrup contains one part of iodine in a thousand. Dose, a teaspoonful.

Chlorides of Iodine. I,Cl. I,Cl_3.

There are two chlorides of iodine, both formed by the absorption of chlorine by dry iodine. When the iodine is in excess, a liquid protochloride is the result. It is a reddish or yellow liquid, of an oily consistence, sharp odor, feebly acid, astringent taste, soluble in water and alcohol. If the chlorine is added in excess, a yellow, solid, crystallizable terchloride is formed; it fumes in the air, has an acrid odor, and is soluble in water. The long-continued action of chlorine, in excess, upon iodine results in the formation of hydrochloric and iodic acids.

Bromine Preparations.

Bittern. The mother-liquor after the crystallization of common salt.

Brominum. Heavy, very volatile liquid, sp. gr. 2.96.

Ammonii Bromidum, NH_4Br. White granular salt, gr. ij to x.

Brominii Chloridum, $BrCl_5$. Very powerful caustic, etc.; fluid.

Potassii bromidum, KBr. White cubical crystals. Dose, gr. v to x.

Liquor ferri bromidi. Solution of bromide with excess of bromine. Dose, ♏v to x.

Brominium, U. S. P. *Bromum*, Br. Ph. *Bromine.* Br=80.

Bromine is a heavy, liquid, non-metallic element, of a red color, stifling odor, and acrid taste; very volatile and fuming, on which account it is generally kept in bottles under a stratum of water, soluble in ether and alcohol, and to a small extent in water; it precipitates starch of an orange color. Associated with iodine in sea-water and numerous mineral springs, it is largely extracted from bittern, the liquor left after the crystallization of common salt, whether from sea-water or from certain salt springs. The process consists in passing chlorine gas or a mixture of binoxide of manganese and muriatic acid, which liberates chlorine, into the bittern, and on distillation the bromine passes over below the boiling temperature. At the salt works in Western Pennsylvania, West Virginia, and Ohio, this bittern is preserved for the extraction of the bromine, and the American bromine prepared there is fully equal to the imported article. According to Prof. Chandler, the product for the year 1870 reached 120,000 pounds, and the price has been constantly depreciating since 1867, and it is now sold at $3 00 to $4 00.

Care should be taken in handling bromine, especially in warm weather, or near a fire; it boils at about 117° F., liberating stifling red fumes, which have the sp. gr. 5.39. Few vapors are so corrosive or so dangerous to those exposed to their inhalation.

Bromine has been prescribed as an antiseptic in purifying the atmosphere of hospitals where erysipelas, gangrene, scarlatina, and smallpox exist, and is used locally in some of these diseases, and internally in diphtheria, and in cases in which iodine has lost its effect from habitual use. With a view to facilitate its employment Dr. J. Lawrence Smith has proposed the following solution:—

Take of	Bromine	A troyounce.
	Bromide of potassium	160 grains.
	Distilled water	Sufficient to make f℥iv.

Dissolve the bromide of potassium in about two fluidounces of water, add the bromine, agitate, and finally add the remainder of the water. It should be kept in small ground-stoppered vials. The dose of this would be from one to two drops.

Bittern, as obtained from the salt works, is a heavy liquid, without color, and having a caustic taste and highly stimulating properties. Its chief medicinal use is to produce a counter-irritant and alterative effect, and, by continued rubbing of the part, a pustular eruption. It is a useful application in rheumatism and in glandular swellings, being absorbed, and producing the alterative effects of the iodine and bromine salts.

Bibron's Antidote to the Poison of the Rattlesnake.—This combination has been found an efficient antidote in a number of cases of poisoning by the rattlesnake's bite.

Mix Iodide of potassium . . . . . Four grains.
Corrosive chloride of mercury . . Two grains.
Bromine . . . . . Five drachms.
Diluted alcohol . . . . . Seven fluidounces and a half.

Take ten drops in a tablespoonful of brandy, repeated as required.

Ammonii Bromidum. Bromide of Ammonium. AmBr.
U. S. P., Br. Ph.

Take of Bromine, two troyounces.
Iron, in the form of wire cut in pieces, a troyounce.
Water of ammonia, four fluidounces and a half.
Distilled water, a sufficient quantity.

Add the iron and then the bromine to half a pint of distilled water contained in a two-pint glass flask, loosely cork the flask, and agitate until there is no odor of bromine and the liquid is of a greenish color. Mix the water of ammonia with half a pint of distilled water, and add it to the mixture in the flask; agitate the mixture, and heat by a water-bath for half an hour; then filter, and when the liquid has all passed, wash the precipitate on the filter with boiling distilled water. Evaporate the solution in a porcelain capsule until a pellicle begins to form, then stir it constantly with a glass rod at a moderate heat until it granulates.

A white granular salt, becoming brown by exposure to the air, freely soluble in water, and slightly so in alcohol. It yields a yellow precipitate with nitrate of silver, and the clear liquid, after the precipitate subsides, gives only a cloud on the further addition of the nitrate.

Chloride of Bromine. $BrCl_5$.

This compound is prepared by passing a stream of chlorine gas through bromine in a freezing mixture, or at a low temperature. It is a reddish liquid, very fluid and volatile, soluble in water, and having a penetrating odor and disagreeable taste.

It has been used externally as a caustic, in combination with chlorides of zinc, antimony, etc., and internally in doses of a fraction of a drop, as a powerful stimulant to the lymphatic system.

Iodine forms two compounds with bromine, but they are little known, and not used in medicine.

Potassii Bromidum, U. S. P., Br. Ph. KBr = 119. (*Bromide of Potassium.*)

Bromide of potassium is obtained by similar processes to iodide, substituting an equivalent quantity of bromine for the iodine. It closely resembles the iodide in most of its properties, and, like it, is an anhydrous salt. It is believed to possess similar medicinal properties to iodide, acting as a powerful alterative, adapted to scrofulous and syphilitic complaints and chronic skin diseases; but its chief use is in cases of excessive wakefulness, "over-worked brain," as a remedy in epilepsy, and as a sedative to the organs of generation. Dose, 10 to 60 grains in 24 hours. Elixir of Calisaya is a good vehicle to disguise its taste.

Tests.—It is very soluble in cold water, more so in hot, slightly soluble in alcohol. By heat it decrepitates, and at a red heat fuses without decomposition or loss of weight. Its aqueous solution does not affect the color of litmus or turmeric, and is not precipitated by chloride of barium. When mixed with starch and heated with HSO_4 it becomes yellow; 10 grains of it require 14.28 grains of nitrate of silver for complete precipitation, and the precipitate formed has a yellow color. If iodine is present it will be shown by adding a few drops of chlorine water to the solution, and then introducing starch-paper, which will show the characteristic blue color caused by iodine.

Monobromated Camphor. $C_{20}H_{15}BrO_2 = 231$.

Thirteen ounces of camphor in small pieces are taken, and as much placed in the neck of a quart retort as will fill it; the remainder is put into the body of the retort, and twelve ounces of bromine are added in portions of from two to four ounces at a time, the larger portions being used at first. The neck of the retort is inclined upwards, so that any liquid which condenses therein will flow back into the retort. To the neck of the retort a tube is attached, which is inserted in a bottle so as to pass just below the cork. A second tube is bent twice at right angles and reaches nearly to the bottom of the bottle, and the other end extends into an open bottle containing eight ounces of water in which an alkali is dissolved for the absorption of the hydrobromic acid.

After the reaction has taken place, the dark oily liquid becomes paler, and the monobromated camphor is purified by crystallizing from petroleum benzine. Further particulars may be obtained by consulting a paper by Prof. J. M. Maisch in *Amer. Journ. of Pharm.* for 1872, p. 337. It is used in doses of one or two grains, frequently repeated, in cases of infantile convulsions. It has also been used in hysteria, headache, and delirium tremens.

Bromide of Sodium. NaBr = 103.

This salt is prepared from bromide of ammonium by adding an equivalent quantity of caustic soda or carbonate of sodium. The solution yields on evaporation eight molecules of the anhydrous salt; at low temperatures it crystallizes in hexagonal tables containing two molecules of water. Its dose is about 15 per cent. less than that of bromide of potassium, ranging from 5 to 40 grains. Its taste is that of common salt.

Liquor Ferri Bromidi.

This preparation was introduced to notice by Dr. Gillespie, of Freeport, Armstrong Co., Pa., who, besides being a practitioner of medicine, is engaged in the bromine manufacture in connection with the salt springs near that place. Dr. G. recommends this solution very highly as a tonic alterative, and it has been successfully used by numerous other practitioners. It is made by macerating

iron filings with bromine under water till they have combined, an excess of bromine being used. The solution, as made by Dr. Gillespie, is given in the dose ♏v to x, three times a day, increased to ♏xxv.

Phosphorus. P = 31.

Phosphorus has, ever since its discovery in 1669, been regarded as a substance of considerable interest, though until our time little used in the arts, and to meet only limited and unusual indications in medicine; its manufacture has, of latter years, received a great impulse from its use in the odorless matches now so extensively introduced. Phosphorus exists in the mineral, vegetable, and animal kingdoms variously combined, the phosphates of calcium, lead, iron, copper, and manganese being its principal native mineral compounds. Phosphate of calcium, potassium, and iron, and free phosphoric acid are extensively diffused in plants, and from these sources it is furnished as a constituent of animal tissues. The bones of animals contain a large proportion of triphosphate of calcium, $Ca_3P_2O_8$, and are used for the preparation of phosphoric acid and phosphorus. The albuminous and fibrinous tissues, "proteine compounds," and the brain contain the element phosphorus, though in minute quantity and in an uncertain state of combination. This element, as is well known, is a constituent in animal excrements, and especially in urine; it is diffused in the air, combined with hydrogen, and is a very important ingredient in a certain class of manures.

Preparation and Properties.—Phosphorus is obtainable from bones, by calcining, treating with oil of vitriol, then subliming with charcoal, and purified. The phosphorus is thus collected, and, being cast into moulds, is found in commerce nearly colorless, in translucent or white cylinders, having a peculiar, almost waxy consistence. It is luminous in the dark, from forming phosphorous acid (PO_3), and is kept under water to prevent gradual oxidation, and to guard against accident from its ready inflammability. When freshly cut it has an odor reminding of garlic, but this is overcome under ordinary conditions by the odor of ozone already referred to. It should be handled with care, and not intrusted to children, who frequently procure it for experiment, without due precaution. Its sp. gr. is 1.8. Melting point, 110° F. It is soluble in ether, oils, naphtha, and bisulphide of carbon, but not in water or alcohol. It is readily powdered by fusion in a vial or flask of moderately warm water or, preferably, diluted alcohol, and shaking up as it cools.

Phosphorus, when taken internally, enters the circulation, imparts to the breath, urine, and sweat a garlic smell, and makes these secretions luminous in the dark; it is absorbed by the skin, and after its solution in a fixed oil has been rubbed upon the stomach all the exhalations are luminous.

Although possessed of very energetic properties, phosphorus is frequently employed internally. In small doses it acts as a stimulant, diuretic, and diaphoretic; in larger doses, one grain and more,

as a corrosive poison; ether and fixed oils, in which phosphorus is soluble, increase and hasten its action. Externally, in the form of liniment, it has been employed with marked success in severe rheumatism, gout, and similar affections. Great caution is necessary in its use.

Red phosphorus is an allotropic variety which is very different from the foregoing in many of its properties; it is not poisonous, but may be administered in considerable doses. If the ordinary kind is kept for several days at a temperature between 465° to 480°, red phosphorus is found at the bottom of the vessel, while the supernatant mass is a mixture of both varieties, from which the ordinary kind may be extracted by bisulphide of carbon.

Red phosphorus is much less inflammable, fusible, and luminous than the ordinary kind; in the presence of moisture and oxygen it is gradually oxidized to an acid liquid, but without phosphorescence; after having been so oxidized, it appears not to be convertible into the translucent or ordinary kind. Phosphorus dissolved in cod-liver oil, or dissolved in ether and mixed with a fixed oil, is not unfrequently prescribed with a view to repair the waste of nerve tissue; the dose under these circumstances may be one-thirtieth of a grain. A pill of phosphorus is also made, preferably by dipping it in a melted fat, and afterwards protecting the pills by gelatine or other suitable coating; but great care is necessary in giving so powerful a remedy.

Black phosphorus is another allotropic variety, sometimes obtained by the repeated distillation of the ordinary kind, but more recently prepared by heating phosphorus with a minute quantity of mercury, from which it may be separated; it is more volatile than normal phosphorus, and is insoluble in bisulphide of carbon.

The application of physiological science to the theory and practice of medicine has recently given rise to numerous experiments upon the usefulness of phosphorous compounds, as nutritive tonics designed to remedy abnormal conditions of the secretions, and to supply the elements wasted in disease.

The late Prof. Samuel Jackson, of the Chair of Institutes in the University of Pennsylvania, whose progressive ideas have had considerable influence upon the methods of practice pursued in this country, was for ten or fifteen years in the habit of prescribing certain preparations containing the phosphates of calcium, iron, sodium, and potassium, in the treatment of anæmic and other low forms of disease. The popularity reached by these preparations has led to the extensive introduction of other remedies prepared on the same principles, and, subsequently, the announcement by Dr. J. Francis Churchill, of Paris, of important properties in the hypophosphites, in which phosphorus is loosely combined, adapting these to the treatment of phthisis, has led to their wide-spread employment. These salts are described under the heads of their several metallic, alkaline, and earthy bases.

Tests.—To detect impurities in phosphorus, it is best to oxidize it by nitric acid; antimony then remains undissolved, while arsenic,

lead, bismuth, copper, and iron may be detected by their various tests; arsenic will produce a yellow precipitate with sulphuretted hydrogen; any sulphur present has been converted into sulphuric acid, with which nitrate of baryta causes an insoluble precipitate. The metals are left behind when phosphorus is purified by dissolving it in bisulphide of carbon; sulphur is not detected in this way, but if pieces of phosphorus are just covered with water, sulphuretted hydrogen will be emitted, which produces a black color with acetate of lead.

Phosphorus combines in four proportions with oxygen:—

Phosphoric acid, HP_2O_5 (three modifications). (*See* Mineral Acids.)
Phosphorous acid, $H_3P_2O_3$. By gradual oxidation of phosphorus in the atmosphere.
Hypophosphorous acid, P_2O. By the decomposition of the phosphuret of an alkaline earth by water.
Phosphoric oxide, P_4O. By the oxidation of phosphorus under water.

The existence of the last-named compound is denied by some chemists, who assert it to be identical with amorphous (red) phosphorus.

Sulphur and its Preparations.

Sulphur. Sublimed sulphur. Yellow crystalline powder. Dose, gr. x to ʒij.
" lotum præcipitatum. A light and very fine powder. " "
Sulphuris iodidum, IS_2. Blackish crystalline masses, used in ointment.

Sulphur Sublimatum, U. S. P. S = 32. (*Flowers of Sulphur, Sublimed.*)

Sulphur is a very abundant substance in the mineral kingdom, existing in combination with the metals, as sulphides or sulphurets and sulphates. Virgin sulphur is a native, tolerably pure form, abundant in Naples, Sicily, and the Roman States, from whence it is imported. By fusion, and running into moulds, roll sulphur or rolled brimstone is prepared, while flowers of sulphur is the result of subliming and condensing it in suitable chambers.

Sulphur has a characteristic yellow color, sp. gr. 1.98, it is without taste and without odor, entirely volatilized by heat, and combustible, burning with a blue color, yielding sulphurous acid gas (SO_2), which is a powerful disinfectant and bleaching agent.

Flowers of sulphur, or sublimed sulphur, is a crystalline powder, of a harsh and gritty character; wholly insoluble in water, alcohol, and ether; soluble in oil of turpentine with the aid of heat; it is the form of sulphur much administered as an alterative and laxative remedy in small doses; being absorbed, it enters the circulation and is given off from the skin as sulphuretted hydrogen. Externally, it is used as a slight stimulant to the skin, and has the power of destroying the *acarus scabiei*, or itch insect, for which it is popularly known as a remedy.

Dose, as an alterative, gr. x to ʒss; as a laxative, ʒss to ʒij, alone or combined with bitartrate of potassium.

Sulphur Lotum. (*Washed Sulphur.*) U. S. P.

This is prepared by sifting the sulphur into a pan containing water, and when it has settled to the bottom, throwing the whole

on a muslin strainer and passing clear water through it till the washings show no acid reaction with litmus paper, then drying and keeping in close bottles. It is preferred by some physicians as less likely to produce griping when administered.

Sulphur Præcipitatum, U. S. P. (*Milk of Sulphur*, *Lac Sulphuris.*)

Made by boiling sulphur and lime together till they combine, forming bisulphuret and hyposulphite of calcium, then adding muriatic acid, which abstracts the calcium, forming chloride, while the sulphur is precipitated as a bulky, light powder. This has a soft and very fine consistence, a grayish-yellow color, and is adapted to suspending in liquids, though little used internally. It should be completely volatilized by heat. Very considerable quantities are consumed in the preparation of hair dressings, in which it is generally combined with acetate of lead, and, by supplying the deficiency of sulphur in hair which has become white or gray, aids in restoring its color. Dose, the same as the foregoing.

Sulphuris Iodidum. SI = 158.3. (*Bisulphuret of Iodine.*)

Take of Iodine	℥iv.
Sulphur	℥j.

Rub the iodine and sulphur together in a glass or porcelain mortar till they are thoroughly mixed. Put the mixture into a matrass, close the orifice loosely, and apply a gentle heat so as to darken the mass without melting it. When the color has become uniformly dark throughout, increase the heat so as to melt the iodide, then incline the matrass in different directions, in order to return into the mass the portions of iodine which may have condensed on the inner surface; lastly, allow the vessel to cool, break it, and put the iodide into bottles, which are to be well stopped.

A suitable vessel for a small operation is a test-tube, or a common, cheap bottle should be selected thin at the bottom. The iodide is in grayish-black, radiated crystalline masses, in odor reminding of iodine, staining the skin yellow, soluble in 60 parts of glycerin; insoluble in water, but decomposed when boiled with it. Two equivalents of sulphur are combined with one of iodine, so that it may be regarded as a bisulphuret.

Internally, this is rarely or never prescribed, but it is much used in the form of ointment applied to chronic and obstinate skin diseases.

Bisulphide of Carbon. CS_2.

This is prepared by passing vapor of sulphur over charcoal heated to redness in cast-iron cylinders. It is purified by repeated washings with water, digestion on quicklime for twenty-four hours, and distilling it into a vessel containing a large quantity of copper turnings. Sp. gr. 1.272. When used internally it acts as a diffusible stimulant. It is largely used in the arts as a solvent, especially for fatty bodies, sulphur, phosphorus, bromine, and iodine.

CHAPTER III.

ON THE INORGANIC ACIDS.

All the inorganic acids employed in pharmacy are compounds rich in oxygen, with the exception of hydriodic, hydrochloric, hydrobromic, and hydrosulphuric, in all of which that element is wanting. The oxides formerly called by chemists acids are now termed anhydrides; the name *acid* being applied to their combination with water.

Acids usually have a sour taste, change the blue color of litmus to red, and affect other vegetable colors similarly; with alkalies, whether vegetable or mineral, they form neutral salts in which the properties of both the ingredients are measurably lost, while new properties are acquired. They also unite with the proper metals, forming a great variety of valuable compounds, which frequently exhibit slightly acid reactions and usually retain the peculiarities of the metal from which they are prepared, modified by the nature of the acid ingredient.

The names of the mineral acids formed from the same element vary in their terminations according as the number of equivalents of oxygen they contain is high or low: thus, sulphur*ic* acid, HSO_4, sulphur*ous* acid, H_2SO_3, Nitr*ic*, HNO_3, Nitr*ous*, HNO_2, Phosphor*ic*, H_3PO_4, Phosphor*ous*, H_3PO_3, Hypophosphorous, H_3PO_2, the degree of acidification being marked by the terminations *ic* and *ous*, and further by *hypo*, which indicates the acid containing less oxygen than that to which its name allies it, or *per* or *hyper*, which indicates a higher oxidation.

The strong acids act upon cork, and should be kept in ground-stoppered bottles, which, as made of extra strength, of green glass, are called acid bottles. Unless the stopper and neck are very well ground and fitted to each other, they require to be cemented or luted together to prevent the escape of the acid; this may be done by warming the stopper in the flame of a spirit lamp, and inserting it in the neck of the bottle till the two surfaces are dried and warmed, then coating it with a thin stratum of melted wax, and inserting it securely in its place, and tying it over with kid or bladder. The more common mineral acids are found in commerce of three qualities; the commonest and cheapest, used for manufacturing purposes, the medicinally pure, M. P., and the chemically pure C. P. The use of the latter is chiefly in analysis. The specific gravity furnishes a ready means of testing the strength of the liquid acids, and the Pharmacopœia indicates this with precision in each case.

The mineral acids generally belong to the class of tonics with refrigerant and astringent properties. Externally, they are caustic, and require to be applied with care, as many know from experience who have used them, nitric acid especially, for warts. Nitric acid is also used as an alterative in syphilitic and other forms of disease, and nitro-muriatic acid for its effect upon the liver in hepatic diseases.

Acids are apt to injure the teeth, upon which they also produce a very unpleasant and characteristic sensation. To obviate this in taking them, they should be largely diluted, and should be sucked through a small glass tube, which may be made by scratching a piece of the tube sold in the shops with a file; this enables the operator to break it at the point required, and then, by heating the sharp broken edges over an alcohol or gas flame till the glass melts, a rounded edge is left.

One of the most important facts in connection with the strong mineral acids is their occasional use accidentally, or for suicide, in poisonous doses. They are among the most powerful of poisons, owing to their corrosive properties producing the most painful and dangerous symptoms. The best antidotes are large draughts of alkaline and oily liquids; the alkali to neutralize the acid, and the oil to obtund its action upon the delicate mucous surfaces. Frequently the most ready resort on such emergencies is soap, which should be made into a very strong solution and given *ad libitum*.

Of the *mineral acids*, the following are used in medicine, and, except those in Italics, are officinal in the *U. S. Pharmacopœia* of 1870:—

Syllabus of Mineral Acids.

Name.	Composition, etc.	Sp. gr.	Dose, etc.
Acid. arseniosum	As_2O_3. See Preparations of Arsenic.	.....	$\frac{1}{10}$ grain.
" *boracicum*	$H_3BO_3+2H_2O$ crystals	1.479	gr. x to ʒj ?
" carbonicum	5 measures CO_2 to 1 water (aq. ac. carbonic.)	.....	
" chromicum	CrO_3 deep red crystals	.....	Caustic.
" muriaticum	Gaseous HCl+water	1.160	♏ iij to v.
" " dilutum	ʒj in fʒiv diluted acid	1.038	♏ xv to xxx.
" nitricum	$2HNO_3+3H_2O$	1.420	♏ j to iv.
" *nitrosum nitricum*	$2HNO_3+3H_2O+N_2O_3$	.....	♏ j to iv.
" nitricum dilutum	ʒiij in Oj diluted acid	1.068	♏ xv to xxx.
" nitromuriaticum	ʒiij nitric to ʒv muriatic	.....	♏ iij to v.
" " dilutum	ʒj in fʒiv dilute acid	.....	♏ xv to xxx.
" sulphuricum	HSO_4	1.843	♏ j to ij.
" " dilutum	ʒij in fʒxvj dilute acid	1.082	♏ xv to xxx.
" " aromat	+Alcohol, cinnamon, ginger	.....	♏ xv to xxx.
" sulphurosum	H_2SO_3 in solution	1.035	Externally.
" phosphoricum glaciale	H_3PO_4 (variable)	.....	gr. ij to iij.
" " dilutum	ʒj to fʒxij water+HNO_3 ℈ij	1.056	♏ xv to xxx.
" *hydrobromicum*	HBr	.....	
" *hydriodicum*	Liquid HI+water	1.112	? ♏ xv to xxx.
" hydrosulphuric	Gaseous H_2S in solution	.....	(Test, etc.)
" hypophosphorous	H_3PO_2+9 aq.	.....	♏ xv to xxx.
" chlorohydrocyanicum	.....	.....	Externally.
" sulphohydrocyanicum	.....	.....	"

Acidum Carbonicum. $CO_2=44$.

This acid ordinarily exists as a gas, though capable of being liquefied and even reduced to a solid form by pressure. It is an invariable constituent of the atmosphere, being exhaled from the lungs of animals and given off from fermenting saccharine liquids and from the combustion of carbonaceous fuel. It is artificially procured by the decomposition of carbonates by any of the strong acids; chalk and marble dust, carbonates of calcium, are the two principal minerals employed for the purpose, and sulphuric or muriatic acid is selected for cheapness and availability. The application of heat is unnecessary, the gas easily escaping with effervescence. It should be passed through a vessel of water to deprive it of any soluble impurity. This gas extinguishes flame, does not support animal life, and is distinguished by rendering lime-water turbid in consequence of converting the hydrate of lime in solution into the insoluble carbonate. The specific gravity of this gas as compared with hydrogen gives its combining number 44, compared with atmospheric air it is 1.529 (53 per cent. heavier than the air). Cold water dissolves rather more than an equal volume of this gas, and the solution sparkles when decanted. The most important uses of carbonic acid to the manufacturing pharmacist are in the preparation of the bicarbonates of sodium and potassium and of carbonic-acid water, misnamed soda water.

Aqua Acidi Carbonici, U. S. P.

This solution is directed to be made by throwing into a receiver nearly filled with water, a quantity of carbonic acid gas equal to five times the bulk of the water; this is to be done by connecting the fountain with a generator by means of suitable pipes and couplings.

The receiver, which is called a fountain, is usually made of copper lined with tin, of the capacity of 15 gallons. A majority of pharmacists purchase the carbonic-acid water from the regular manufacturers, either owning or hiring the fountains; but those to whom the sale of the article as a beverage is a source of sufficient profit to justify the expense frequently have apparatus for manufacturing it on the premises.

In the first edition of this work two of these were figured, but as they are described in the illustrated circulars of the makers, which are numerous and accessible to all who wish to acquaint themselves with their relative advantages and prices, I omit them here and insert the following convenient form of apparatus.

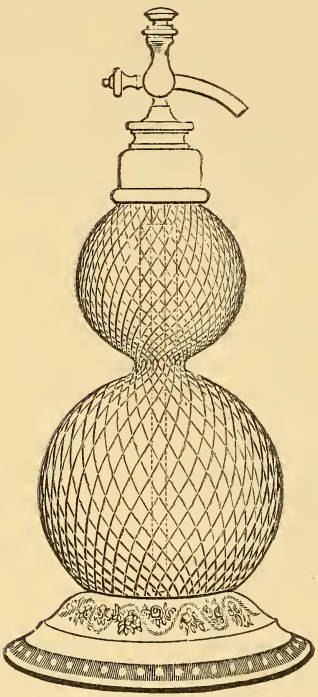
Fig. 171 represents a French *gasogene*, such as are imported of various sizes, from one quart to five gallons capacity.

This is a strong glass vessel consisting of two bulbs joined together at their point of union by a tube of about half an inch bore extending into the upper one to near the top. The upper bulb is surmounted by a metallic cap, on to which is screwed a draught pipe with a valve, opened by pressing with the thumb upon the

button at the upper extremity of a rod; attached to this draught pipe is a long glass tube of small diameter, passing through the larger tube, occupying the central space, to near the bottom of the apparatus. The object of this mode of construction is to permit the charging of water, placed in the lower bulb, with gas generated from carbonated alkali and acid placed in the upper bulb, without contaminating the water with the salts.

Fig. 172 shows a section of the upper part, with the mode of filling the lower bulb with water by a long funnel, *e*, extending through the cap and neck of the apparatus, *d*, into the large tube, *f*; this obviously prevents any portion of water escaping into the upper bulb; the lower bulb is designed to be filled in this way about three-fourths full of cold water.

Fig. 171.



Gasogene.

Fig. 172.

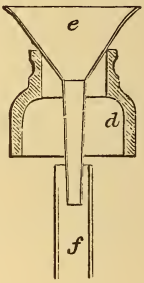


Fig. 173.

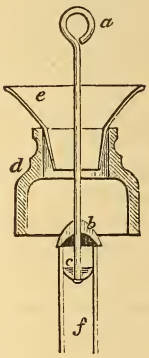


Fig. 173 illustrates the ingenious arrangement for introducing the bicarb. soda and tartaric acid (one of which should be in crystals partially powdered) into the upper bulb; *a* is a rod with a metallic cone, *b*, of a diameter greater than the glass tube, *f*, and a leather washer, *c*, which is thrust into the tube and completely closes it. The wide-mouth funnel, *e*, is introduced into the cap and neck of the apparatus, and the dry salts, mixed, thrown into it;

these, falling over the cone, *b*, lodge in the upper bulb; the rod and funnel are now removed, and the draught pipe screwed on.

By tilting the apparatus some of the water runs through the larger tube into the upper bulb, and partially dissolving the mixed powders, sets them to combining; a brisk evolution of carbonic acid ensues, and, by shaking, its absorption by the water is facilitated. By opening the valve in the draught pipe, the charged water, by its own elasticity and the pressure of the excess of gas, is driven up the narrow tube and through the valve, and escapes. The object of the wire coating is to protect from injury in case of explosion, a purpose it but imperfectly fills.

The water introduced may be flavored with syrup, or it may be drawn into a glass containing the flavoring ingredient. The absorption of the gas is greatly facilitated by the refrigeration of the water, and by frequently shaking in up.

This apparatus may serve the purpose of pharmacists who do not desire to dispense carbonic-acid water as a beverage, but need to keep it on hand for prescription purposes. Gasogenes are chiefly imported from Paris, and sold for six dollars and upwards. The siphon bottle now sold by many manufacturers of mineral waters is an admirable substitute for the gasogenes, enabling pharmacists to dispense carbonic-acid water in small quantities, pure and without trouble to themselves.

The chief use of carbonic-acid water in prescription is for dissolving saline substances in making aperient and antacid draughts, for suspending magnesia, for making solutions of citrate of potassium, and occasionally by itself as a grateful drink to allay thirst and lessen nausea. As a vehicle for magnesia or saline cathartics, eight fluidounces are usually prescribed, to be taken at once, or in divided portions frequently repeated. It parts with the gas upon exposure, and should, therefore, be used as soon as possible after the cork has been drawn. Sometimes, when prescribed in small doses, it is dispensed in one-ounce or two-ounce vials, which are to be kept cold and securely corked, the contents of each being taken separately, directly from the mouth of the vial.

The chief impurities to which carbonic-acid water is liable are the carbonates of copper and lead, derived from the fountain and pipe from which it is drawn. These, particularly the former, render carbonic-acid water not only worthless, but injurious; they may be detected by the metallic taste they impart to it, by the addition of ammonia, which gives a blue tint to the salts of copper, and by the ferrocyanide of potassium, which gives a garnet-colored precipitate, if copper is present. Iodide of potassium indicates the presence of lead by a yellow precipitate.

Soda-water *coolers* and *syrup holders* are necessary to all who dispense this beverage. One of the forms of cooler consists of a coil of half-inch pipe disposed around the inside of a circular cedar tub placed under the counter; the pipe is terminated by a small air chamber, in which any excess of the gas is allowed to collect, so as to be drawn off by a screw; this appendage may be omitted where

the bore of the pipe exceeds ¼ of an inch, and where it is not very long. The size of the tub and length of the pipe may be regulated by circumstances; where the demand for the water is constant in hot weather, the tub should hold half a bushel of ice, and the pipe be at least fifty feet in length. An objection to this arrangement is found in the fact that the portion of the pipe between the top of the tub and the end of the draught pipe is not refrigerated, and the water it contains and the first which passes through it are invariably drawn off first into the glass This is obviated by the construction of coolers upon the counter, which may or may not supersede the necessity of the cooler just described.

The cooler for the counter may combine an ornamental vase or box and draught pipe with the advantage of a coil surrounded by ice. Connected with this, the cooling of the syrups, also, is a desideratum, and many years ago I contrived a vase, which consists of a central, oval cylinder of galvanized iron, closed at the lower end, and containing a coil of block-tin pipe thirty feet long, coupled on to a lead pipe communicating with the copper fountain underneath, and is terminated by a draught pipe in the side of the vase; this central cylinder holds about half a peck of broken ice; outside of this, and fitting closely against it, were eight syrup cans with a plated faucet at the base of each, arranged as closely as possible to admit of their being conveniently used, and all proceeding from the part of the vase facing behind the counter. This ice cylinder and series of cans formed a perfect circle with straight sides, and over the hole a tin casing fitted accurately, having the proper external contour to form a graceful vase, and the intervening space between this and the inside cylinders was occupied by an air-chamber, which furnished a non-conducting medium between the ice and the external warmth. In order to have the syrup cans movable for the purpose of repairs, the faucets were all on a line corresponding with the floor of the vase, and the external casing had scallops cut out at its base corresponding with these and the draught pipe, so that the whole fitted accurately together, and could be taken apart at pleasure.

This apparatus was well adapted to an establishment where the sale was limited or the supply of ice small. It was of too little capacity for a large establishment, requiring to be too frequently replenished with ice. The number of syrups this cooler contained being limited, a further assortment was required to be kept in bottles, or in a separate syrup cooler.

The same principle has since been carried out on a much larger scale in coolers of a great variety of sizes and constructions, which, being well protected by layers of non-conducting material, or constructed of marble, and holding a large quantity of ice, require replenishing only once or twice a day in the hottest weather; some of these have twelve syrup cans of half a gallon to one gallon each, enough for a full assortment of syrups.

The inconvenience, in drawing syrups from a faucet, of a drop collecting at the tip of the pipe after it has been shut off, is obvi-

ated by an invention of Isaac S. Williams, of Philadelphia, by which a flat disk of metal moves with the lever and closes the end of the pipe as soon as the flow is stopped; by this contrivance the intrusion of flies and ants into the faucet is guarded against. Another form of faucet is so constructed as to measure the quantity of syrup, delivering just enough for a single draught each time it is opened.

Artificial Mineral Waters.

Some pharmacists, who dispense largely carbonic-acid water, connect with this branch of their business the following, which they draw from separate draught pipes connected with fountains in the cellar, or, as in the case of Saratoga water according to the following formulas, they add the pure salts and the pure carbonic-acid water in the glass:—

Artificial Saratoga Water.

Mix Chloride of sodium	ʒj.
" magnesium, solution*	fʒij.
Bicarbonate of sodium	ʒj.
Solution of iodine (Lugol's)	fʒss.
Tincture of chloride of iron	fʒss.
Carbonic-acid water	Ojss.

Filter. Into a Oj tumbler introduce fʒj of the mixture, fill it up with carbonic-acid water, and drink immediately.

Artificial Kissingen Water.†

Chloride of potassium	2.20	Sulphate of calcium	3.
" of sodium	44.70	Phosphate of "	.04
Bromide of sodium	.64	Carbonate of "	8.14
Nitrate of "	.07	" of iron.	.24
Chloride of lithium	.15	Silicic acid	.10
" of magnesium	2.34	Ammonia	.007
Sulphate of "	4.50	Water	Oj
Carbonate of "	.13		

Acidum Boracicum. (*Boracic Acid.* $H_3BO_3 = 62.$)

For medicinal purposes this acid is prepared from borax. Mitscherlich recommends the following process: Four parts of borax are dissolved in ten parts of boiling water, and decomposed by two and a half parts of strong muriatic acid; on cooling, hydrated boracic acid separates in shining scaly crystals, which are purified by recrystallization.

Muriatic acid is preferable to sulphuric acid for its extraction, because the boracic acid can be easily purified from the former acid adhering to it, while sulphuric acid can only be entirely expelled by exposing the product to a strong heat, or by precipitating the hot solution with a sufficient quantity of nitrate of baryta.

The acid is free of odor, has a bitter taste, dissolves in 20 parts of cold water and 5 parts of alcohol. It reddens litmus, its weak

* Commercial muriatic acid saturated with magnesia.

† For other formulas see *Pharmacist* for 1870, p. 169.

solution giving a brownish wine red, and imparts to curcuma paper a peculiar brown color. On boiling the solution much acid evaporates with the aqueous vapor; its alcoholic solution burns with a green flame.

Impurities which it may contain are detected by alcohol, which leaves most of them behind; sulphuretted hydrogen, if metallic salts are present; chloride of barium, if sulphuric acid, and nitrate of silver, if muriatic acid is present. The salts of boracic acid are all soluble, and are decomposed in solution by most acids.

Boracic acid is classified as a sedative; it is not much used in medicine, except in combination with soda, as borax, and with bitartrate of potassium, which it renders soluble. (See *Potassii et Boracis Tartras.*)

Acidum Chromicum. (*Chromic Acid.* $Cr_2O_3 = 50.75$.) U. S. P.

Prep.—To 100 parts, by measure, of cold saturated solution of bichromate of potassium, 150 parts of pure sulphuric acid are added and allowed to remain till cool; the sulphuric acid unites with the potassa, and the chromic acid crystallizes in deep red needles—very soluble and deliquescent. It is a powerful oxidizing and bleaching agent, and acts as a solvent of organic matter. In medicines its chief use is a caustic application, which, it is said, is less painful than most others, and, when rightly managed, does not spread beyond the prescribed limits, and so soon as its corrosive operation is finished passes into the state of inert pulverulent sesquioxide; diluted with two parts of water, it has been used with success as an injection in uterine hemorrhage. When heated to a temperature between 356° and 374° it melts into a reddish-brown liquid, which, on cooling, becomes a red, opaque, brittle mass. If a few drops of alcohol are allowed to fall on a small portion of the acid, a vigorous action takes place, attended with an increase in bulk, and the liquid formed becomes yellowish-brown.

Acidum Muriaticum. (*Hydrochloric or Chlorohydric Acid.* $HCl = 36.5$.)

Prepared by the action of sulphuric acid and water on chloride of sodium (common salt); bisulphate of sodium and hydrochloric acid are formed; the latter gas is distilled over, the process being conducted in a retort or flask, connected with a receiver containing water, which absorbs it rapidly in proportion as it is refrigerated. A colorless or slightly yellow transparent liquid, giving off white acid fumes on exposure to the air. The sp. gr. of the medicinal acid is 1.16, which contains 31.8 per cent. of real acid.

Rationale.—In the reaction two equivalents of chloride of sodium and one of sulphuric acid are used, and the hydrogen of the sulphuric acid is replaced by the sodium of the chloride of sodium, sulphate of sodium and hydrochloric acid being the result: $2NaCl + H_2SO_4 = 2HCl + Na_2SO_4$. Or, an equivalent of each being used, one-half the quantity of hydrochloric acid is obtained, and the acid sulphate of sodium: $NaCl + H_2SO_4 = HCl + NaHSO_4$. Only one-half of the hydrogen in each molecule of sulphuric acid

is here replaced by sodium, and this, combining with the one equivalent of chlorine of the chloride of sodium, forms one equivalent of muriatic acid.

Tests.—It should not dissolve gold leaf, as shown by the acid after digesting with it giving no precipitate with protochloride of tin. The absence of metallic and saline impurities is shown by its being entirely volatile, and yielding no precipitate with chloride of barium, hydrosulphuric acid, or ammonia in excess.

Reactions.—Muriatic acid may be recognized by the evolution of chlorine on treating a muriate with HSO_4 and MnO_2; by the white precipitate occasioned by a soluble lead salt which is insoluble in ammonia and acids but soluble in much hot water; by the white precipitate produced in proto-salts of mercury, which are rendered black by ammonia, which dissolves very slowly in boiling muriatic or nitric acids, but readily in chlorine water and in aqua regia; by the white precipitate with nitrate of silver, which acquires a dark, ultimately black color in the sunlight, and is insoluble in nitric acid, but readily soluble in ammonia.

Acidum Muriaticum Dilutum, U. S. P.

Take of Muriatic acid	4 troyounces.
Distilled water	A sufficient quantity.

Mix the acid, in a glass vessel, with sufficient distilled water to make the diluted acid measure a pint.

The specific gravity is 1.038. By the early editions of the *Pharmacopœia* fluid measure was designated instead of weight, so that the strength of the resulting diluted acid was dependent upon the weight of the strong acid employed; by directing the weighing of the strong acid any deficiency in its specific gravity is compensated by an increase of quantity, so that the resulting diluted acid cannot vary widely from the standard. Its dose, as a tonic, is from 15 to 40 minims, largely diluted.

Acidum Hydrochloricum Dilutum, Ph. Br.

Take of Hydrochloric acid	8 fluidounces (Imp.).
Distilled water	A sufficiency.

Dilute the acid with 16 ounces of the water, then add more water so that at the temperature of 60° F. it shall measure 26½ fluidounces, or mix 3060 grains of the acid with sufficient water to measure one pint; the specific gravity of this is 1.052; six fluidrachms contain one equivalent of 36.5 grains of hydrochloric acid, HCl. Its strength, compared with the diluted muriatic acid of the U. S. P., is as 51 to 32. Its dose is from 10 to 30 minims, largely diluted.

Acidum Nitricum, U. S. P. (*Nitric Acid.* $2H,NO_3 + 3H_2O = 90$.)

Prepared by the action of sulphuric acid upon nitrate of potassium (saltpetre) in a glass retort, when, on the application of heat, nitric acid and sulphate of potassium are formed. The acid, being volatile, is distilled over by the application of heat. It is a color-

less, transparent liquid, with powerfully acrid odor, and is exceedingly corrosive, staining the skin yellow. The strongest acid, containing one equivalent of water, has the specific gravity 1.521; but, owing to the presence of water in the ingredients used in its preparation, and its mixing readily in all proportions with water, it is usually weaker, and has its specific gravity reduced in proportion to its dilution. In the *Pharmacopœia* of 1840 the officinal strength was 1.5, but it has been changed in the more recent editions to 1.42, as stated in the Syllabus, the object being to adapt it more nearly to the usual strength of the commercial article, and to establish a standard easily attained. The portion added to water in making the diluted acid was changed to correspond, and in the last edition, by the substitution of weight for measurement in designating the quantity, greater uniformity was secured.

If nitric acid of a higher specific gravity than 1.42 be distilled, a stronger acid passes over first, and the boiling point of the residue in the retort gradually rises to 253°, when the officinal acid of 1.42 is distilled. An acid lighter than 1.42 also boils at a lower temperature, distilling a still weaker acid, the boiling point gradually rising to 253°, when it remains stationary; the officinal acid now distils, containing 60 per cent. HNO_3, and 40 per cent. H_2O.

Rationale.—The formation of nitric acid in heating equal weights of nitrate of potassium and sulphuric acid, is thus explained in accordance with the views of modern chemists.

$$KNO_3 + HSO_4 = KSO_4 + HNO_3.$$

If half the quantity of sulphuric acid is taken, the neutral sulphate of potassium, which is hard and only slightly soluble, and hence difficult to remove from the retort, is the residuum. The formula would be as follows:—

$$2KNO_3 + HSO_4 = K_2SO_4 + 2HNO_3.$$

Tests.—The principal impurities are, nitrous acid, which is shown by a red color; sulphuric acid, which may be detected by adding to the diluted acid a solution of chloride of barium; and chlorine or muriatic acid, which would occasion a white precipitate with nitrate of silver.

Reactions.—Nitric acid is remarkable for furnishing salts which are invariably soluble, except some basic salts, of which the officinal subnitrate of bismuth is an example.

Cyanide of potassium, mixed with a nitrate and heated on platinum foil, causes detonation and ignition.

Copper filings, if mixed with a nitrate, will cause the evolution of red nitrous acid fumes after the addition of concentrated sulphuric acid.

The solution of a nitrate, to which concentrated sulphuric acid has been added, and afterwards a crystal of protosulphate of iron, acquires a deep brown color around the crystal, which disappears on agitation or on heating. Added to morphia or one of its salts, nitric acid strikes a blood-red color, which changes to yellow; a

reaction which may also be produced by heating a nitrate in a test-tube with a drop of sulphuric acid, and then adding morphia; the same effect is produced by brucia and commercial strychnia.

Acidum Nitricum Dilutum, U. S. P.

Take of Nitric acid, three troyounces.
Distilled water, a sufficient quantity.

Mix the acid in a glass vessel with sufficient distilled water to make the diluted acid measure a pint.

The specific gravity of this is 1.068. Dose, 15 to 40 minims, largely diluted.

Acidum Nitricum Dilutum, Ph. Br.

Take of Nitric acid, six fluidounces.
Distilled water, a sufficient quantity.

Dilute the acid with 24 fluidounces of the water, then add more water so that at the temperature of 60° F. it shall measure 31 fluidounces (imperial); or take of nitric acid 2400 grains to sufficient water to make a pint.

The specific gravity of this acid is 1.101. Dose, 10 to 30 minims, largely diluted.

Nitrous acid (though, correctly speaking, the name is applied to a red-colored gas, having the composition HNO_2, formed whenever binoxide of nitrogen, NO, escapes into the air) is commonly understood in trade to apply to fuming red-colored nitric acid, such as passes over chiefly at the commencement and close of the process of distilling nitrate of potassium with sulphuric acid, as above. This kind of nitric acid contains nitrous acid fumes, which the manufacturers usually separate from the acid of commerce by boiling, thus rendering it colorless. The best and most distinctive name for the article under consideration is *nitroso-nitric acid*. Its chief use to the apothecary is in making Hope's camphor mixture, which is elsewhere spoken of as having peculiar value when made with this form of acid. As the preparation of nitric and nitroso-nitric acid may often be desirable to the physician or apothecary, and as it is an easy and instructive experiment to the tyro, a description of the process, as practised in a small way, is appended.

A retort and receiver, such as are figured in Chapter I., Fig. 146, will answer the purpose. If the receiver is well refrigerated, there will be no difficulty in collecting the acid; no luting of any kind is used. Nitrate of potassium, with half its weight of oil of vitriol (one equivalent of each), is now distilled; at about 250° the acid commences to pass over, afterwards the heat is increased, when the apparatus becomes filled with red fumes, which are absorbed by the nitric acid in the receiver, and with oxygen, which escapes; when the acid ceases to come over, the process is completed.

On first decomposing the nitre, the sulphuric acid unites with one-half of the potassium, to form bisulphate of potassium, which, above 400°, acts on the other half of the nitre, setting nitric acid free, which is decomposed into nitrous acid and oxygen.

The red fuming acid should be put away for use in glass-stoppered bottles; if the colorless NO_3 is preferred, it is heated or exposed to the air, to allow of the escape of the nitrous fumes.

An extemporaneous process for the production of nitrous fumes in nitric acid is to drop, into a vial containing it, a few chips of some pure kind of wood; on this, part of the HNO_3 will act, producing oxidation of the ligneous matter, and liberating red fumes. This process is only suggested where the last is impracticable.

When free nitrous acid is mixed with a considerable quantity of water, it is instantly resolved into nitric acid, which unites with the water, and binoxide of nitrogen escapes with effervescence, but this change does not occur in the presence of nitric acid, for which nitrous acid has a strong affinity.

Acidum Nitromuriaticum, U. S. P. (*Aqua Regia.*)

Take of Nitric acid, three troyounces.
Muriatic acid, five troyounces.

Mix them in a glass vessel, and, when effervescence has ceased, keep the product in a well-stoppered bottle, in a cool place, protected from the light.

This forms a deep yellow, corrosive, fuming liquid, containing chlorine and nitric oxide in an unknown state of combination. The acid dissolves gold, from the free chlorine present. It should be made in small quantities as required, care being taken, in dispensing it, to allow the effervescence to cease before securing the stopper in the bottle.

Acidum Nitromuriaticum Dilutum, U. S. P.

Take of Nitric acid, a troyounce and a half.
Muriatic acid, two troyounces and a half.
Distilled water, a sufficient quantity.

Mix the acids in a well-stopped bottle having the capacity of a pint. Shake them together occasionally during twenty-four hours, and then add sufficient distilled water to make the diluted acid measure a pint. Lastly, keep it in a cool place, protected from the light.

This diluted acid is a new officinal and a convenient and long-needed preparation for the practitioner. The eminent usefulness of nitromuriatic acid as a tonic and stimulant to the liver makes it important that a preparation of convenient strength for use should be provided by the pharmacist. The chlorine and nitric oxide eliminated from the strong acid are fully retained in solution in the water here added to them. The dose is from 15 to 30 drops, which should be administered in a considerable quantity of sugar and water, preferably sucked through a glass tube so as not to affect the teeth.

Acidum Sulphuricum, U. S. P. (*Oil of Vitriol*, *Sulphuric Acid*, H_2SO_4.)

Made by burning sulphur and nitrate of potassa together in leaden chambers. Sulphur, when burned, forms sulphurous acid

(SO_2), which, in contact, in the form of vapor, with nitrous acid from the burning nitre, and water, becomes more highly oxidized into sulphuric acid, HSO_4.

It is an oily-looking, very heavy liquid (sp. gr. 1.843), without color when pure, having no odor, but an intensely acid caustic taste. It becomes darkened in color by contact with vegetable substances, which it chars by abstracting from them the elements of water. When mixed with water, it readily combines with it, disengaging heat; its strong affinity for water is one of its useful properties. When largely diluted with water, it is apt to deposit a white precipitate of sulphate of lead derived from the leaden vessel used in concentrating it. It unites with alkalies and alkaline earths, and separates all other acids more or less completely from their combinations with these.

Reactions.—It is easy to determine the nature of this acid, whether free or in combination; its characteristic reaction is a white precipitate with all soluble salts of barium, which is insoluble in water, in acids, and alkalies.

Impurities.—Sulphate of lead is apt to be present in sulphuric acid, and may be detected and separated by dilution with an equal bulk of water, which will separate it as a white cloud. Arsenic is an occasional impurity, which may be detected by sulphuretted hydrogen, giving a yellow precipitate when passed through it. Arsenic, if present in sulphuric acid, may be removed by adding some muriatic acid, and heating, when, by double decomposition, water and chloride of arsenic are formed, the latter readily volatilizing; it is necessary to evaporate the excess of water from the acid afterwards (Buchner's method). To avoid this, Loewe proposed to add chloride of sodium to the heated acid gradually, as long as arsenical vapors are emitted; the sulphuric acid will be contaminated with a little sulphate of soda, which, however, does not render it unfit for any ordinary purpose.

Medical Properties.—It is only prescribed internally in one of the officinal diluted forms which follow, though occasionally the strong acid is used in ointments. It is a powerful tonic, an antiseptic, and a refrigerant, and, externally, is used as a caustic, though rather unsuited for that use.

Acidum Sulphuricum Dilutum, U. S. P.

Take of Sulphuric acid, two troyounces.
Distilled water, a sufficient quantity.

Add the acid gradually to fourteen fluidounces of distilled water, and mix them; after twenty-four hours filter through paper and pass sufficient distilled water through the filter to make the diluted acid measure a pint. The specific gravity of this is 1.082. The white precipitate at first formed, on mixing with water (sulphate of lead), will be separated on the filter, leaving the pure diluted acid. Its dose is from 15 to 40 minims, freely diluted.

Acidum Sulphuricum Aromaticum, U. S. P. (*Elixir of Vitriol.*)

Take of Sulphuric acid, six troyounces.
Ginger, in coarse powder, a troyounce.
Cinnamon, in coarse powder, a troyounce and a half.
Alcohol, a sufficient quantity to make two pints.

Add the acid gradually to Oj alcohol, and allow the liquor to cool. Mix the ginger and cinnamon, and, having put them into a percolator, pour alcohol gradually upon them until a pint of tincture is obtained. Lastly, mix the diluted acid and the tincture.

Formerly, the tincture was made by treating the powdered aromatics directly with the mixed alcohol and acid. The present process is an improvement, giving a clearer and more elegant tincture, though still liable to precipitate an apothemelike deposit. Elixir of vitriol is stronger than diluted sulphuric acid, though its dose in drops is usually about the same, the alcoholic liquid giving smaller drops than the aqueous.

This preparation is very extensively used as a refrigerant, tonic, and astringent. It is a popular remedy for night-sweats in phthisis, and for debility generally. In making solutions and pills of quinine, also in the officinal infusions of cinchona, it has important pharmaceutical uses.

Acidum Sulphurosum, U. S. P. (*Sulphurous Acid.*)

Take of Sulphuric acid, eight troyounces.
Charcoal, in coarse powder, a troyounce.
Distilled water, thirty-six fluidounces.

Pour the acid upon the charcoal, previously introduced into a matrass, and shake them together. Connect the matrass with a washing bottle, and this, by means of a bent glass tube reaching nearly to the bottom of it, with a two-necked bottle containing the distilled water. To the other neck of this bottle attach another bent tube, and let it dip slightly into a solution of carbonate of sodium. All the joints having been properly luted, apply heat to the matrass until gas ceases to be evolved, preventing the temperature of the distillate from rising, by means of cold water applied to the bottle containing it. Lastly, pour the sulphurous acid into half-pint bottles, which must be well-stopped, and kept in a cool place.

When sulphuric acid, H_2SO_4, is heated in contact with certain oxidizable substances, among which is common charcoal, it parts with one equivalent of oxygen, and is converted into sulphurous acid, SO_3; this is a gas very soluble in water, and by passing it into a vessel containing water it is absorbed, and constitutes the liquid acid. The intervention of a wash-bottle containing water and of an additional bottle of carbonate of sodium is to remove any portions of sulphuric and carbonic acids, the latter a product of the oxidation of the carbon. This is a new preparation in the *Pharmacopœia;* it is adapted to the treatment of certain skin diseases, but practitioners have as yet but little familiarity with its uses. It is a powerful antiseptic and bleaching agent, and the gas, when liberated, is corrosive and suffocating.

It is a colorless liquid, having the odor of burning sulphur, and

a sulphurous, sour, and somewhat astringent taste. Its specific gravity is about 1.035. When saturated with ammonia, and then treated with an excess of chloride of barium, it should afford a clear or nearly clear solution on the addition of muriatic acid in excess.

Acidum Phosphoricum Glaciale, U. S. P. (*Phosphoric Acid.* H_3PO_4.)

This is prepared from calcined bones (bone phosphate of lime), by decomposing them with sulphuric acid, by which process a superphosphate of lime is produced (the article used as a basis for the manure known by that name). The superphosphate is neutralized by carbonate of ammonium, which generates phosphate of ammonium in solution with precipitation of phosphate of calcium. By calcining phosphate of ammonium at a red heat, the volatile ingredient is expelled, and the solid H_3PO_4 remains combined with 1, 2, or 3 equivalents of water, or is a mixture of the tri-, the bi-, and the monobasic acid; the amount of water being dependent on the temperature.

This acid hence exists in three allotropic modifications: 1, the ordinary tribasic, which is capable of uniting with three equivalents of a metallic oxide, and precipitating silver salts yellow; 2, pyrophosphoric acid, prepared by calcination of a phosphate, which unites with but 2 equivalents of a base, and precipitates silver salts white; 3, meta-phosphoric acid, obtained by burning phosphorus in oxygen or atmospheric air; this unites with only one equivalent of a base, precipitates silver salts white, and has the property of coagulating albumen. To convert the two lower hydrates into the tribasic acid, Prof. Maisch recommends the use of nitric acid, as in the formula for the diluted acid. He finds that of three specimens examined, the percentage of anhydrous H_3PO_4 was respectively 70.2, 77.19, and 83.48 per cent.

To obtain glacial phosphoric acid pure, the fusion must take place at a considerable elevation of temperature in a platinum vessel; vessels of clay, porcelain, and glass, which are generally employed by large manufacturers, are objectionable for this purpose, as the resulting acid is more or less contaminated with lime, magnesia, and silicic acid, which render the crystals slow of solution. Even silver vessels are corroded by the melted acid. Two specimens taken from the same jar, of Merck's manufacture, were found by Prof. Maisch (see *American Journal of Pharmacy*, 1860, p. 193) to be contaminated in the one case with .794 per cent., and in another with .818 per cent., of these impurities.

As far as I am acquainted with the source of the phosphoric acid in the American market, it is all of the manufacture of Merck, of Darmstadt, although it is also made by Morson & Son, of London, and by several other manufacturers on the Continent of Europe, who exhibited specimens at the Industrial exhibition in London. It is in transparent, glossy looking, solid and very hard, though slightly deliquescent, masses, of an intensely sour taste, without odor, and freely, though somewhat slowly, soluble in water and alcohol, dissolving with a characteristic crackling sound.

"Its aqueous solution is not precipitated by hydrosulphuric acid, and no precipitate takes place after the liquid has stood for forty-eight hours. Chloride of barium causes a white precipitate, which is readily dissolved by an excess of the acid. Ammonia in excess produces but a slight turbidness, and caustic potassa in excess evolves no ammonia."

There are many curious properties of phosphoric acid compounds which show them to occupy an intermediate place among chemical agents, between mineral and organic bodies, to possess most unusual polymeric properties, and a pliancy of constitution which, to use the language of Graham, "peculiarly adapts the phosphoric above all other mineral acids to the wants of the animal economy."

Acidum Phosphoricum Dilutum, U. S. P. (*Diluted Phosphoric Acid.*)

Take of Phosphorus, three hundred and sixty grains.
Nitric acid, five troyounces, or a sufficient quantity.
Distilled water, a sufficient quantity.

Mix five troyounces of nitric acid with half a pint of distilled water, in a porcelain capsule, of the capacity of two pints. Add the phosphorus, and invert over it a glass funnel of such dimensions that its rim may rest on the inside of the capsule, near the surface of the liquid. Place the capsule on a sand-bath, and apply a moderate heat until the phosphorus is dissolved and red vapors cease to arise. If the reaction become too violent, add a little distilled water; and if the red vapors cease to be evolved before the phosphorus is all dissolved, gradually add nitric acid, diluted to the same extent as before with distilled water, until the solution is effected. Then, removing the funnel, continue the heat until the excess of nitric acid is driven off, and a syrupy liquid, free from odor and weighing two ounces, remains. Lastly, mix this, when cold, with sufficient distilled water to make it measure twenty fluidounces, and filter through paper.

Diluted phosphoric acid may also be prepared by dissolving a troyounce of glacial phosphoric acid in three fluidounces of distilled water, adding to the solution forty grains of nitric acid, boiling it until reduced to a syrupy liquid, free from the odor of nitric acid, and then adding sufficient distilled water to make the diluted acid measure twelve fluidounces and a half.

The first of these processes is too inconvenient to be generally followed by pharmacists who have ready access to the glacial acid. It is founded on the well-known power of nitric acid to part with two equivalents of its oxygen by contact with substances having a strong affinity for that element. Of these, phosphorus is a remarkable instance, and unless precautions are taken to check the reaction, as in the formula, it is accompanied by violent explosion, with danger of the ingredients being thrown out of the vessel; the use of an inverted funnel to prevent this is an admirable expedient.

The second process, founded on the experiments of Prof. Maisch, on the conversion of the monohydrated into common or tribasic acid, contains a modification of the process given in the last edition

of this work, by the introduction of nitric acid, which is afterwards driven off by boiling; the resulting acid is then of the kind that unites with three equivalents of a base, and precipitates the salts of silver yellow.

It is a colorless liquid without odor, of an agreeable acid taste, sp. gr. 1.056. It is used in the dose prescribed in the Syllabus as a tonic. It is employed in the preparation of the phosphatic lozenges and of the syrups of phosphate of lime and other preparations of the kind.

The vapors of boiling diluted phosphoric acid are without action on litmus-paper; the acid is not rendered turbid by alcohol, and no precipitate is occasioned by the dilute solution of a barium salt, which remains not entirely dissolved in an excess of phosphoric acid, nor is it soluble in nitric and muriatic acids, but freely in muriate of ammonium. Arsenic is sometimes present, either from the phosphorus or the sulphuric acid employed, and it is then in the state of arsenic acid; to detect it, the acid is first mixed with sulphurous acid and heated to expel the excess added, after which the addition of sulphuretted hydrogen causes a yellow precipitate. Solution of sulphate of calcium produces a white precipitate soluble in acids. Magnesium salts in the presence of free ammonia cause a white precipitate insoluble in ammonia and ammonia salts, but dissolving in acids.

A solution of a phosphate acidulated with muriatic acid produces with a drop or two of sesquichloride of iron, and the subsequent addition of acetate of potassium, a gelatinous, white precipitate of phosphate of sesquioxide of iron.

Acidum Hydriodicum Dilutum. HI + Aq.

Take of Iodine, in fine powder, a troyounce.
Distilled water, a sufficient quantity.

Mix thirty grains of iodine with five fluidounces of distilled water in a tall glass-stoppered bottle, having the capacity of half a pint, and pass into the mixture hydrosulphuric acid gas until the color of the iodine entirely disappears, and a turbid liquid remains. Detach the bottle from the apparatus employed for introducing the gas, and gradually add the remainder of the iodine, stirring at the same time. Then reattach the bottle, and again pass the gas until the liquid becomes colorless. Decant the liquid into a small matrass, which it is nearly sufficient to fill, boil it until it ceases to emit the odor of hydrosulphuric acid, and filter through paper. Then pass sufficient distilled water through the filter to bring the filtered liquid to the measure of six fluidounces. Lastly, keep the liquid in a well-stopped bottle.

The hydrosulphuric acid gas required in this process may be obtained by mixing, in a suitable apparatus, a troyounce and a half of sulphuret of iron, two troyounces of sulphuric acid, and six fluidounces of water.

The *rationale* of the process is this: the sulphydric acid, the formula of which is H_2S, reacts upon 2I, forming 2HI and free sulphur, which separates upon the filter.

It is considered to possess the medicinal properties of free iodine

without its local irritating effects if diluted with water; it has been given in doses commencing with a few drops, gradually increasing, two or three times a day. It is a good solvent for iodine.

Diluted hydriodic acid is a sour liquid, colorless when recently prepared, and having the specific gravity of 1.112. It is wholly volatilized by heat, and is decomposed by nitric and sulphuric acids, with the liberation of iodine. When kept in contact with the air, it gradually becomes brown, and acquires an iodine odor.

Acidum Hydrobromicum. HBr.

This acid may be readily obtained by decomposing bromide of potassium with a concentrated solution of phosphoric acid; it is also a secondary product in the preparation of monobromated camphor.

Acidum Hydrosulphuricum, Hydrothionicum. HS.—Sulphuretted hydrogen occurs naturally in the so-called sulphur springs, many of which have a high reputation as remedial agents. The White Sulphur Springs, in Virginia, and the far-famed Aix la Chapelle, Warmbrun, and Baden Springs, in Germany, and the springs at Harrowgate, in England, Moffat, in Scotland, Barèges, Cauterets, in France, and many others, owe their celebrity, in part, to sulphuretted hydrogen. These springs never contain it alone to the exclusion of other gases; nitrogen, oxygen, carburetted hydrogen, and carbonic acid are often found in the same waters.

This acid is prepared artificially by mixing an ounce and a half of black sulphuret of iron with two ounces of sulphuric acid, and six of water, in a flask, and conducting the gas through a glass tube and wash bottle into water. The iron, being oxidized by the oxygen of the water, liberates the hydrogen, which, in its nascent state, combines with the nascent sulphur to form this gaseous acid, which, after being washed by passing it through a little water, is conducted into distilled water, kept well refrigerated.

It is a colorless liquid, of a penetrating, disagreeable odor, like rotten eggs, and when inhaled acts as a poison.

In contact with air, it is decomposed, hydrogen being oxidized to water, and sulphur precipitated. Hydrosulphuric or sulphydric acid precipitates a large class of metallic salts, and is, on that account, very much used as a test liquid in analytical researches.

It is free of sulphuric acid if no precipitate occurs with chloride of barium, and of muriatic acid if the filtrate from the precipitate with nitrate of copper occasions no precipitate with nitrate of silver.

The natural sulphur waters are much used in rheumatic and cutaneous diseases; externally as baths, and also freely in large draughts.

The aqueous solution of this acid is not, I believe, prescribed as a medicine.

Acidum Hypophosphorosum. H_3PO_2.

Hypophosphorous acid is a compound of phosphorus and oxygen, one equivalent of each, PO. It requires, however, not less than three equivalents of water to form the liquid acid, and of these,

two equivalents enter into its salts, one only being replaced by bases. When heated, these salts emit phosphuretted hydrogen, a peculiar self-inflammable gas (fire-damp), of an odor reminding some of garlic. They are permanent in the air, but in solution, by heat, are liable to absorb oxygen; they are all soluble in water, and a few are crystalline. Several processes have been used to produce these salts. Rose recommends boiling phosphorus in a solution of caustic baryta till all the phosphorus disappears, and the vapors have no longer the garlic odor. Lime is found to answer the same purpose, and is commonly used. Hypophosphite of lime is perhaps the most important of these salts; by oxidation in the animal economy, it is probably converted into readily assimilable nascent phosphate of calcium, and by decomposition it furnishes the other salts of this acid and the acid itself.

So far as I am aware, this acid has not been prescribed in a free state, but it is highly probable that it may come into use. Any claims which phosphoric acid may possess as an agent to supply the waste of phosphorus and phosphates in the human economy, must be more than equalled by this acid. Hypophosphite of barium is the salt which is most eligible for the preparation of this acid, but it is convenient to prepare it from the calcium salt, viz.:—

Take of Hypophosphite of calcium . .	480 grains.
Crystallized oxalic acid . . .	350 grains, or sufficient.
Distilled water	9 fluidounces.

Dissolve the hypophosphite of lime in six ounces of the water and the acid in the remainder, with the aid of heat; mix the solutions, pour the mixture on a white paper filter, and when the liquid has passed, add distilled water carefully till it measures ten fluidounces, and evaporate this to eight and a half fluidounces.

The solution thus prepared contains about ten per cent. of terhydrated hypophosphorous acid ($H_2O + 2H_2O,PO$), a teaspoonful representing six grains of the acid, which contains two and a quarter grains of phosphorus. The dose of this acid solution would vary from ten minims to a teaspoonful.

Acidum Chlorohydrocyanicum.—If fulminating silver is decomposed by muriatic acid, chloride of silver is precipitated, hydrocyanic acid evolved, and the liquid contains chlorohydrocyanic acid—

$$2AgO,C_2NO + 7HCl = 2AgCl + HC_2N + 4HO + C_2H_2NCl_5.$$

It was discovered by Liebig.

It has been employed by Drs. Turnbull and Turner in paralytic and torpid diseases of the eye and the ear, by exposing the diseased parts for half a minute to the vapors of one drachm of the acid contained in a sponge in a proper vial. It acts as a stimulant, producing a slight irritation and sensation of heat, and dilates the pupils less than hydrocyanic acid.

Acidum Sulphohydrocyanicum, Rhodanicum.—It has been found in the seed of mustard and other cruciferæ, and in the saliva of animals; but it is uncertain whether pre-existing or the result of a decomposition by reagents. To prepare it, powdered anhydrous

ferrocyanuret of potassium is fused with flowers of sulphur at a moderate heat, dissolved in water, some oxide of iron precipitated by potassa, the filtrate evaporated, and the concentrated solution distilled with phosphoric acid.

It is a colorless liquid, of a sour taste, which, when concentrated, is readily decomposed on keeping, but keeps unaltered for a considerable time in a diluted state. Its characteristic property is to impart a blood-red color to all neutral persalts of iron, and to assume the same color in contact with paper, cork, and other organic bodies containing oxide of iron.

It has been used by Dr. Turnbull in diseases of the eye, in a manner similar to chlorohydrocyanic acid.

CHAPTER IV.

THE ALKALIES AND THEIR SALTS.

Alkalies are electro-positive bodies; they may be divided into inorganic alkalies, which are oxides of peculiar, light, and very combustible metals, and organic alkalies or alkaloids. Ammonia forms a connecting link between these, and may be classed with either, though most conveniently with the former. The four alkalies used in medicine, and to be presented in the present chapter, are, potassa, soda, lithia, and ammonia. They possess in common the property of turning vegetable reds to green or blue, and the yellow color of turmeric, and some other vegetable yellows, to brown. They neutralize acids, deprive them more or less of acidity, and form with them salts which are sometimes acid, sometimes alkaline, and sometimes neutral, according to the proportions and relative strengths of the acids employed.

The laws which govern the formation of salts have been very thoroughly studied, and are fully laid down in works on chemistry; a knowledge of these, in connection with the system of nomenclature founded on them, is in the highest degree important, whether to the practical or theoretical chemist.

The plan of this work embraces only such reference to the laws of combination as the pharmaceutical history of some of the leading chemicals will necessarily bring into view. The officinal names are partly chemical and partly empirical, being, as more fully explained in the chapter on the Pharmacopœia and its Nomenclature, framed with a view to distinctness and adaptation to the purpose, rather than to chemical accuracy or elegance.

In chemical works, the classification of these is in accordance with their chemical relations and affinities, while in treatises on materia medica, they are arranged according to their therapeutical properties. In a pharmaceutical work like the present, it will be well, perhaps, to present yet a different arrangement, and bring them into view with reference to their commercial sources and

modes of preparation. The following arrangement is adopted in this chapter. The alkaline salts are classified into syllabi, and treated in the same rotation in the text.

GROUP 1ST.—*Alkaline Salts prepared from natural mineral deposits.*
" 2D.—*Salts, starting with wood ashes.*
" 3D.—*Salts, starting with common salt.*
" 4TH.—*Salts, starting with crude tartar.*
" 5TH.—*Preparations of ammonia.*

Potassa, soda, lithia, and ammonia, in their caustic condition (or combined with carbonic acid, which rather modifies than changes their medicinal properties), are used in medicine chiefly for neutralizing excess of acids existing in the secretions. In the case of ammonia, this use is combined with a powerful arterial stimulant property, adapting it to low forms of disease. The salts formed by these alkalies with the acids vary in their therapeutical properties. Some have a special tendency to the skin, some to the kidneys, some to the bowels, etc. Their physical properties are no less various; although they are mostly crystalline, some assume a pulverulent or amorphous form. The salts of potassium are generally disposed to deliquesce or become damp, while those of sodium effloresce, or lose their water of crystallization, falling into powder. Those of ammonium, by decomposition, liberate their volatile and alkaline base, known by its pungency and by the production of a white cloud when brought in contact with vapor of muriatic acid.

The class of salts formed by muriatic acid with the alkalies and earths have been found to be compounds of chlorine with the metallic radicals of these, and might be considered with the so-called hydriodates (iodides) among the halogen compounds, but are usually classed with the oxysalts.

The oxysalts of the alkalies are nearly all soluble. The bitartrates of potassium and ammonium, and the antimoniate of sodium, which occur as white crystalline precipitates, constitute exceptions, and in their production furnish tests for potassa and soda respectively. The great solubility of the alkalies and their compounds constitutes a prominent distinction between them and the earths, to be presented in another chapter.

Most alkalies, both organic and inorganic, may be detected by forming with bichloride of platinum, especially in the presence of free muriatic acid, yellow crystalline double chlorides of platinum and the alkali, which, with the exception of soda and a few organic alkalies, are precipitated from a concentrated solution, by alcohol.

If a potassium salt is heated in the blowpipe flame, the outer flame is colored violet; the same color is produced on igniting alcohol mixed with a salt; in both cases soda ought not to be present, as the color is obscured by it. Soda imparts an intensely yellow color to flame.

It will be noticed that the names of the alkaline salts are changed in the termination of their basic constituents. This is in accordance with the nomenclature adopted by the *U. S. Pharmacopœia*, as noticed in Part II.

Equivalent Weights of Citric Acid, Tartaric Acid, Carbonate of Potassium, Bicarbonate of Potassium, Carbonate of Sodium, Bicarbonate of Sodium, Carbonate of Ammonium, and Carbonate of Magnesium; repeated (in **black**) for 20 parts of each, and incidentally (in roman) for other proportions. (Exact to two places of decimals.)

Citric Acid ($H_3C_6H_5O_7,H_2O$) ÷ 3 × 2 = 140	**20.00**	18.66	**16.96**	**14.00**	**9.78**	**16.66**	**23.72**	**29.31**
Tartaric Acid, $H_2C_4H_4O_6$ = 150	21.43	**20.00**	**18.26**	**15.00**	**10.49**	**17.85**	**25.42**	**31.41**
Carbonate of Potassium, K_2CO_3 + 16 % Aq. = 164.285 .	**23.47**	**21.90**	**20.00**	16.43	11.48	19.52	27.87	34.40
Bicarbonate of Potassium, $2(KHCO_3)$ = 200	**28.57**	**26.66**	24.34	**20.00**	13.98	23.81	33.89	41.90
Carbonate of Sodium, $Na_2CO_3,10H_2O$ = 286	**40.08**	**38.13**	34.81	28.60	**20.00**	34.04	48.47	59.98
Bicarbonate of Sodium, $2(NaHCO_3)$ = 168	**24.00**	**22.40**	20.45	16.80	11.74	**20.00**	28.47	35.18
Carbonate of Ammonium, $(N_4H_{16}C_2O_8)$ ÷ 2 = 118 . . .	**16.85**	**15.73**	14.36	11.80	8.25	14.04	**20.00**	24.71
Carb. of Magnes. $((MgCO_3)_3,Mg2HO,4H_2O)$ ÷ 4 = 95.5	**13.64**	**12.73**	11.62	9.55	6.68	11.37	16.18	**20.00**

The amount of acid given in any column will saturate the amount of carbonate in the same column, and *vice versâ*.
The amounts of carbonate in any column are equal to each other in chemical power.
Lemon-juice (sp. gr. 1.039) contains, on an average, 7 per cent. by weight of citric acid.

The same Table in round numbers, for purposes of prescribing and dispensing.

(The old names in Latin.)

Citric Acid	**20**	19	**17**	**14**	**10**	**17**	**24**	**30**
Tartaric Acid	22	**20**	**18**	**15**	**11**	**18**	**26**	**32**
Carbonate of Potassium (Potassæ Carbonas)	**24**	**22**	**20**	16	12	20	28	35
Bicarbonate of Potassium (Potassæ Bicarbonas). . . .	**29**	**27**	24	**20**	14	24	34	42
Carbonate of Sodium (cryst.) (Sodæ Carbonas)	**40**	**38**	35	28	**20**	34	49	60
Bicarbonate of Sodium (Sodæ Bicarbonas).	**24**	**22**	20	17	12	**20**	29	36
Carbonate of Ammonium (Ammoniæ Carbonas)	**17**	**16**	14	12	8	14	**20**	25
Carbonate of Magnesium (Magnesiæ Carbonas)	**13**	**13**	11	9	7	11	16	**20**

The Table is read thus: 20 grains of Citric Acid will saturate 29 grains of Bicarbonate of Potassium; 20 grains of Bicarbonate of Sodium will saturate, or be saturated by, 18 grains of Tartaric Acid; 11 grains of Tartaric Acid = 8 grains of Carbonate of Ammonium; 20 grains of Bicarbonate of Sodium are equivalent to, or will do as much work as, 34 grains of Carbonate of Sodium; 14 grains of Citric Acid are as strong as 15 of Tartaric Acid. It is occasionally convenient to double the numbers, halve them, or take some other proportion; also to employ them in weights other than grains.

Lemon-juice contains, on an average 32½ grains of citric acid in 1 fluidounce, or 4 grains per fluidrachm.

The Alkalies and their Salts.

Group 1.—*Alkaline Salts—Prepared from Natural Mineral Deposits.*

Potassii nitras, KNO_3. From incrustations on the soil in India and elsewhere.
Sal prunelle, KNO_3. Fused with a little sulphur, and containing a trace of sulphate.
Potassii chromas, K_2CrO_4. From chrome iron ore and nitrate of potassium by fusion, etc.
Potassii bichromas, K_2CrO_4,CrO_3. From chromate by an acid.
Potassii bisulphas, $KHSO_4$. The residuum of the process for nitric acid.
Potassii sulphas, K_2SO_4. By adding KO to the residuum of the process for nitric acid.
Sodii boras, $2NaBO_2,2HBO_2,9H_2O$. Found native in Thibet, and purified.
Sodii nitras, $NaNO_3$. Found native in desert in Peru.
Sodii tungstas, $NaWO_4$. From native tungstate of calcium.
Sel de Vichy, Na_2CO_3. By separating Vichy spring water.
Lithia, LiO. Existing in several minerals and mineral waters.
Lithii carbonas, $LiCO_3$. Precipitated by carb. ammonium from the chloride.

Potassii Nitras. (*Nitre.* KNO_3.)

Nitre, or Saltpetre, is imported from the East Indies, where it is extracted from the soil by mixing them with a little wood-ashes, lixiviating with water, and crystallizing. It is refined in this country by recrystallization, and then exists in large six-sided, nearly colorless prisms, anhydrous, soluble in four parts of cold water, and with a cooling, rather sharp taste.

Among the uses of nitrate of potassium in pharmacy, are the preparation of nitric acid, of spirit of nitric ether, and of collodion. Owing to the immense consumption of it in a pure form by the manufacturers of gunpowder, they are resorted to for procuring the best qualities for medicinal use. Dupont, near Wilmington, Delaware, furnishes a fine article both in crystals and in the form of a granular powder. It is one of the most popular of the refrigerant, diuretic, and sedative medicines. Dose, gr. v to ʒj. In overdoses it acts as a corrosive poison.

Test.—Much of the saltpetre of commerce is adulterated with nitrate of sodium and chloride of sodium (common salt). In the absence of these, 100 grains of the dry salt, treated with 60 grains of sulphuric acid, and the whole ignited in a crucible till it ceases to lose weight, yield 86 grains of sulphate of potassium. The presence of chlorides may be shown by treating a weak solution with a few drops of solution of nitrate of silver, which would throw down a white insoluble precipitate of chloride of silver.

Sal Prunelle.—This is fused saltpetre run into round moulds about the size of a filbert, of a white color, and possessing the properties of the nitrate. From the use of sulphur in its fusion, it often contains sulphate of potassium. It is used to dissolve in the mouth in affections of the throat.

Sodii Nitras. (*Cubic Nitre.* Na,NO_3.)

This salt is found in the desert of Atacama, in Peru, where it forms beds of vast extent. The natural deposits contain chlorides and sulphates of sodium, and other bases in variable proportions. The native salt, therefore, requires to be purified by recrystalliza-

tion from twice its weight of boiling water, when it is generally sufficiently pure for medicinal purposes. It is used in the manufacture of sulphuric and nitric acids, and of manures. In a state of purity, suitable for use in medicine, it may be made by neutralizing carbonate of sodium with nitric acid, evaporating, and crystallizing. It has been highly recommended in dysentery in a dose of from half an ounce to an ounce in a day, in mucilage.

It crystallizes in rhombohedrons, detonates less violently than saltpetre upon burning charcoal, when it shows a yellow flame. Its solution in distilled water is not disturbed by any reagent, except those few precipitating the soda; chlorides are detected as above.

Potassii Chromas. K_2,CrO_4.

This salt is obtained in large manufactories as a preliminary step to the preparation of the bichromate, by melting powdered chrome iron ore (FeO,Cr_2O_3) with saltpetre, dissolving it out with water, evaporating, and crystallizing. For pharmaceutical use it may be conveniently made by adding carbonate of potassium to a solution of the bichromate until it has acquired a slight alkaline reaction. It occurs in lemon-yellow prisms of a bitter, almost styptic taste, requiring little more than two parts of water at 60° for its solution, which has an alkaline reaction; it is insoluble in alcohol.

It is an irritating resolvent, alterative, and emetic; the dose is one-eighth of a grain every two or three hours; or from 2 to 4 grs. as an emetic. It is used in the preparation of a cheap writing fluid with extract of logwood.

Potassii Bichromas. K_2,CrO_4,CrO_3.

This salt is prepared from chromate of potassium, by adding to a solution of the latter sulphuric acid, which abstracts an equivalent of the base from two of the chromate, and leaves one equivalent of the bichromate in solution. As obtained in commerce it is sufficiently pure for medicinal purposes; it crystallizes in prisms, which are isomorphous with the anhydrous bisulphate of potassium, but the latter, owing to its greater solubility in water, can be easily removed by recrystallization if present. Bichromate of potassium has an orange-red color and a cooling, bitter, metallic taste; it is soluble in 10 parts of water at ordinary temperature, but is insoluble in alcohol.

It has been employed as a powerful alterative in the dose of $\frac{1}{20}$ to $\frac{1}{15}$ grain, repeated two or three times daily. In larger doses, $\frac{3}{4}$ to 1 grain, it acts as an emetic, but its use is dangerous on account of its irritating poisonous properties. It has been externally employed as a caustic and irritant in the form of a concentrated solution, and in powder. In pharmacy it is employed as an oxidizing agent in the preparation of valerianic acid.

Tests.—Muriatic acid or common salt is detected by nitrate of silver; sulphuric acid or sulphate of potassium by chloride of barium; salts of sodium by antimoniate of potassium; lime and

magnesia (as nitrates, from imperfect purification) by carbonate of potassium; metallic oxides by sulphuretted hydrogen and ferrocyanide of potassium.

Potassii Bisulphas. (*Bisulphate of Potassium.* $KHSO_4$.)

Contained in the residuum of the preparation of nitric acid from nitrate of potassium, or obtained from the neutral sulphate by fusing it together with an excess of sulphuric acid, and recrystallizing it.

It is readily soluble in water, and has a bitter acid taste; it contains $2H_2O$. It is used occasionally in cases of constipation when the tonic effect of an acid is desired. The dose is one or two drachms.

Potassii Sulphas. (*Vitriolated Tartar.* K_2,SO_4.)

Sulphate of potassium is prepared from bisulphate, the residuum left after treating nitrate of potassium with sulphuric acid, for the distillation of nitric acid; it is also a residuary product in the manufacture of sulphuric and of tartaric acid. To obtain the sulphate from bisulphate, lime is added, which on boiling abstracts the excess of sulphuric acid, and is precipitated as sulphate of calcium; by boiling with carbonate of potassium the excess of lime and sulphate of calcium is removed, and the sulphate of potassium is then obtained pure by crystallization. The crystals are hard, heavy, and usually regular in their shape, being short six-sided prisms, terminated by corresponding pyramids. It is slowly soluble in 9½ times its weight of cold and less than 4 times its weight of boiling water. It consists of one equivalent of sulphuric acid 96, and one of potassium 78.2 = 174.2.

It is used in the preparation of Dover's powder, but in this country is rarely given alone or in any other combination. It is esteemed a cathartic in doses of ʒj to ʒij, and often prescribed as such in Europe, especially in cases of pregnancy.

Tests.—Lime or its sulphate is detected by oxalate of potassium; muriatic acid or chlorides by nitrate of silver; metallic oxides by sulphuretted hydrogen. It is not often adulterated or sophisticated.

Sodii Boras. (*Borax.* $2NaBO_2,2HBO_2,9H_2O$.)

Borax is found native in Thibet, and imported in a crude condition from India, also manufactured from native boracic acid in Tuscany. In its refined condition it is in large and handsome white crystals, semi-transparent, with slight alkaline reaction, and slightly alkaline not disagreeable taste, soluble in 12 parts of cold water. Borax consists of two equivalents of boracic acid and one of sodium. The proportion of water of crystallization appears to vary with the process of crystallization, though generally, as stated in the syllabus, ten equivalents. This salt is called *bi*-borate of sodium, because it contains two equivalents of its acid constituent, and *sub*-borate of sodium because it is alkaline in its reaction. It is thus anomalous in its relation to nomenclature.

It is a diuretic and antacid, and by some is said to promote contraction of the uterus, to which end it is associated with ergot. It is a very favorite addition to gargles and mouth-washes—being much prescribed for the sore mouth of infants, triturated with sugar, 1 part to 7, and touched to the tongue, or blown into the mouth through a quill.

It is remarkable for its whitening effect upon ointment, upon which it seems to act by its sub-alkaline properties, partially saponifying them without materially diminishing their bland and emollient effects.

Tests.—Alum is detected by a white precipitate occasioned by carb. of potassium; metallic oxides by sulphuretted hydrogen; sulphuric acid by nitrate of barium, if the precipitate is insoluble in water; muriatic acid by nitrate of silver, if the precipitate is insoluble in nitric acid.

Tungstate of Sodium. $Na,WO_4 + 2H_2O$.

This salt has been introduced as a preservative of cotton and other textile materials from fire. Tungstic acid consists of three equivalents of oxygen combined with one of the metal tungsten; it is obtained from the native tungstate of calcium by digesting it with hydrochloric acid; chloride of calcium is dissolved, and tungstic acid precipitates. It is also obtained from wolfram, a native tungstate of manganese and iron, by digesting it in nitrohydrochloric acid, which dissolves the oxides of iron and manganese, and leaves the tungstic acid as a yellow powder. This acid is quite insoluble in water and acids, but dissolves in alkaline solutions. Tungstate of sodium may be formed by fusing the wolfram with carbonate of sodium, and digesting in water, which dissolves out the sodium salt, and on evaporation yields it in crystals containing two equivalents of water.

The mode of using it upon clothing to be protected from fire is as follows:—

To three parts of good (dry) starch, add one part of tungstate of sodium, and use the starch in the ordinary way.

If the material does not require starching, mix in the proportion of one pound of tungstate of sodium to two gallons of water—well saturate the fabric with this solution, and dry it.

The heat of the iron in no way affects the non-inflammability of the fabric.

Vichy Salt for making Artificial Vichy Water.

There are two saline substances under this name, obtained by evaporating the water of the celebrated Vichy spring, in Germany; the one, consisting chiefly of carbonate of sodium, crystallizes out when the waters are evaporated to a sp. gr. of about 1.200; the other is produced by evaporating to such an extent that the residual saline mass sets upon cooling, and therefore contains nearly if not quite all the mineral constituents not susceptible of decom-

position by the process. The first of these salts is used for making Vichy water extemporaneously, the second for baths.

Lithia. $LiO = 23$.

This alkali is the oxide of a rare metal resembling sodium, which floats on rock oil, and is the lightest of all known solids. Sp. gr. .5986. It belongs to the class of alkalies, as its carbonate is soluble and has an alkaline reaction.

Lithia exists in small quantities in the minerals spodumene or triphane, petalite, and lepidolite, but the most abundant source of it has been a native phosphate Triphylene, found in Bavaria, consisting of phosphates of iron, manganese, and lithium. This mineral is dissolved in hydrochloric acid, the iron peroxidized by NO_3, the solution diluted, and the phosphate of iron thrown down by ammonia. The manganese is removed by H_2S, and the filtered liquid on evaporation calcined and treated with alcohol, which takes up the chloride of lithium. This source of lithia is said to be now exhausted. It is also prepared from lepidolite or lithium mica, in which it is associated with silica, alumina, and potash, and from the waters of Kreuznach, in Prussia, and of certain mineral springs of Baden.

All the salts of lithium impart a red color to flame, similar to that from strontium; sodium hides this color. The double phosphate of lithium and sodium is a very insoluble salt, requiring 1400 parts of water at 59° for solution; hence, phosphate of sodium is used as a test for its soluble salts.

Lithii Carbonas. (*Carbonate of Lithium*, $Li,CO_3 = 36.95$.)

Carbonate of lithium is slowly precipitated from a solution of chloride by the addition of carbonate of ammonium in excess; it is then washed with alcohol and dried.

In the year 1843, Alexander Ure, of London, drew attention to an observation of Lipowitz, that a solution of carbonate of lithium exerts a remarkable solvent power upon uric acid, and suggested that advantage might be taken of this fact by injecting into the bladder such a solution, with a view to dissolve or disintegrate uric acid calculi.

In 1857, Dr. Garrod, of London, commenced its administration internally in cases of gouty diathesis and chronic gout. The atomic weight of this alkali being very low, it possesses a proportionate saturating power upon acids, and it has been found by experiments that carbonate of lithium will dissolve urate of sodium from a piece of gouty cartilage more efficiently than either bicarbonate of potassium or of sodium. Dr. Garrod found that in doses of one to four grains, dissolved in water, and repeated two or three times a day, it produced no physiological symptoms, but exerted a marked influence in cases where the patients were voiding uric acid gravel, causing the formation of these deposits to diminish and

even to cease. In gout it is found to diminish the frequency and severity of the attacks.

The carbonate is a white powder, having a decidedly alkaline taste, not unlike that of bicarbonate of sodium; it requires about 100 times its weight of water for solution. For internal use the solution is made very dilute, and, advantage being taken of the solvent action of carbonic acid, it is usually dissolved in the proportion of five to ten grains in a half pint of carbonic-acid water. Dose, a wineglassful three or four times a day. In cases of gout, where more decidedly alkaline solutions are indicated, it may be associated with bicarbonate of sodium or of potassium. The maximum dose is four grains three times a day.

Group 2.—*Salts, Starting with Wood-ashes.*

Potash. Lixivium from ashes of forest trees evaporated to a dark hard mass.
Potassii carbonas impura. Ignited potash. Pearlash.
Saleratus. Dry pearlash subjected to gaseous CO_2.
Potassii carbonas, $K_2CO_3,3H_2O$. Solution pearlash filtered and granulated.
Potassii bicarbonas, $KHCO_3$. Passing CO_2 into solution carbonate, etc.
Potassii carbonas pura, $K_2CO_3,3H_2O$. Calcining bicarbonate, granulating.
Liquor potassæ. Boiling carbonate with hydrate lime, sp. gr. 1.065.
Potassa, KHO. Evaporating liquor potassæ to dryness, and fusing.
Potassa cum calce. Equal parts potassæ and lime triturated and sometimes fused together.
Potasii acetas, $2K\overline{Ac}$. Neutralizing acetic acid with carbonate, and crystallizing.
Potassii citras, $3K\overline{Ci}$. Neutralizing citric acid with carbonate, and granulating.
Liquor potassii citratis. A variety of extemporaneous processes.
Potassii phosphas, $2KH_2PO_4$. By combining $3HPO_4$ with 2 eq. K_2CO_3.
Potassi hypophosphis, KH_2PO_2. By precipitating hypophosphite lime with carbonate potassium.
Potassii chloras, $2K,ClO_3$. Passing excess of chlorine through solution potassæ.
Sodii chloras, $NaClO_3$. Decomposing chlorate of potassium with bitartrate of sodium.
Potassii silicas. Fusing together silica and K_2CO_3.
Potassii picras. Saturating picric acid with KHO.

It is remarkable that the only available source of carbonates of potassium is from the combustion of vegetable organizations, which, by absorbing the salts of the alkalies in solution in the water permeating the soil, have assimilated these into their structure, and on their combustion they are obtained in the ashes, remaining unconsumed. By lixiviating the ashes of forest trees and evaporating the lye, potash is obtained, and by subjecting this to the action of flame it is converted into pearlash.

Potash and *pearlash*, though important in their relations to the arts and to domestic economy, are seldom employed in medicine, except in the preparation of the other forms of caustic and carbonated alkali, and the other salts of potassium enumerated in the table.

Saleratus is a useful and tolerably pure sesquicarbonate of potassium, prepared by subjecting pearlash to the fumes of fermenting substances, from which it absorbs additional carbonic acid. It occupies a position intermediate between the carbonate and bicarbonate, and is much used in baking to furnish the carbonic acid which raises the bread, rendering it light and porous. Light cakes

made with it are generally considered less objectionable by dyspeptics than those made with yeast. Recently most of the saleratus of the shops is an imperfectly carbonated bicarbonate of *sodium*.

In the last edition of the *British Pharmacopœia* a series of test solutions has been directed, termed volumetric solutions from the fact that each measure of them (by *volume*) contains a definite quantity of the given chemical; and when a given volume of test liquid is consumed, it is at once known how much of the chemical has been used; then by the table of equivalents the purity of the chemical tested by the volumetric solution can be ascertained at once. The facility with which these solutions can be used makes it a subject of surprise that they have not been introduced much more generally long since, as the same method has been employed in assays of silver by Gay-Lussac's method for nearly if not quite fifty years.

Potassii Carbonas. (*Salt of Tartar.* $K_2CO_3 3H_2O$.)

Made by dissolving pearlash in an equal weight of cold water, filtering or decanting to separate insoluble matters, and evaporating, stirring actively so as to form a granular powder, which is very deliquescent, and usually contains water in the proportion of three equivalents to every two of salt. It is soluble in its weight of water. It contains traces of sulphate of potassium and chloride of potassium, which do not interfere with its medicinal uses; it also contains silica in the form of silicate of potassium, which, on absorbing CO_2 from the air, is precipitated. Dose, gr. x to ʒss, largely diluted, as an antacid; externally it is prescribed in lotions containing ʒij to Oj of water.

A new source of supply for the potassium salts has been lately pointed out by Mr. Herbert Hazard, viz., the ashes of the corn-cob. (See *Amer. Journ. Pharm.*, 1872, page 152.)

Potassii Bicarbonas. (*Bicarbonate of Potassium.* K,HCO_3.)

Made by passing carbonic acid gas (generated by the action of diluted sulphuric or muriatic acid on chalk or marble) into a solution of carbonate of potassium in about three parts of water unto saturation, then evaporating at a heat not exceeding 160°, and crystallizing.

This operation may be conducted with an arrangement of bottles such as is shown in Fig. 166, the gas being passed through water to free it from impurities, and then discharged into the solution of carbonate in a beaker or other suitable containing vessel. The point of saturation may be judged proximately by the bubbles of gas ceasing to diminish in size as they escape through the body of the solution.

If the solution is saturated, the formation of crystals will commence in the containing vessel as soon as the requisite quantity of the gas has been absorbed. The *rationale* of the process is, that the carbonate of potassium, having a strong affinity for carbonic acid, is

converted into bicarbonate by absorbing an additional equivalent, a reaction which, in this instance, requires one equivalent of water, which gives to this salt a determinate and uniform composition— $K_2CO_3 + H_2O + CO_2 = 2KHCO_3$. Bicarbonate of potassium is in large transparent crystals, with a mild alkaline taste, soluble in about four parts of water.

The uniformity of this salt fits it for use as a test for the strength of acids, and it is directed in the *Pharmacopœia* as the test to ascertain the strength of acids, which it neutralizes in the ratio of their strength.

The following table exhibits the proportion of bicarbonate of potassium which neutralizes 100 grains of each of the acids named:—

Acetic acid, strong, 60 grains. Diluted, 7.5 grains.
Diluted nitric acid, 20 grains.
Diluted sulphuric acid, 25 grains.
Citric acid, crystallized, 150 grains.
Tartaric acid, crystallized, 133.5 grains.

Tests.—The bicarbonates, if fully bicarbonated, do not precipitate sulphate of magnesium, by which they may be known from carbonates.

The presence of monocarbonate of potassium is proved by a reddish precipitate occasioned with corrosive sublimate.

A precipitate by an excess of caustic alkalies shows the presence of earthy or metallic oxides.

A residue after treating the salt with nitric acid, evaporating and redissolving in water, proves the presence of silicic acid; a precipitate in this solution, with silver or baryta salts, indicates muriatic or sulphuric acid.

By being calcined, this salt loses 30.7 grains of water and carbonic acid, forming the pure carbonate of the *Pharmacopœia.*

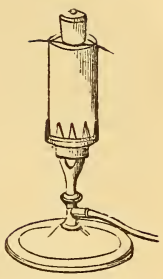
Uses.—As a medicine, bicarbonate of potassium acts as a direct and efficient antacid, more pleasant and efficient than bicarbonate of sodium and more acceptable to the stomach than the carbonate. It readily neutralizes free acid in the stomach; the excess being absorbed renders the blood and urine decidedly alkaline, and it is hence considered alterative in its action. It is used to liberate carbonic acid, and for making the saline preparations of potassa is preferred to carbonate, being free from silica. Dose, ℈j to ʒj.

Potassii Carbonas Pura.

The ignition of the potash forming pearlash deprives it of organic matter, and brings it more completely into the condition of a carbonate. The solution, filtration, and granulation of this deprive it of some inorganic impurities, but leave it contaminated with silica. Charging it with a further dose of carbonic acid precipitates this impurity; and, finally, calcination at a red heat will drive off the additional dose of carbonic acid and the water of crystallization, and leave the pure carbonate. This is directed to be dissolved

and granulated, by which it will absorb water as in the case of the ordinary carbonate. The only use to which it is applied is as a test, and when absolute purity is required. An iron crucible is directed in the *Pharmacopœia* for this purpose, but a porcelain or a platinum crucible will serve in small operations.

Fig. 174.



Metallic chimney and crucible support.

Fig. 174 shows the mode of suspending a crucible of small size over a gas lamp chimney by a bent wire; a similar arrangement may be adopted in using the Russian or other alcohol lamps. I have illustrated and described this more fully, because on a small scale it is readily practicable, and it is frequently difficult to obtain the chemically pure carbonate. Formerly this was directed to be prepared by igniting bitartrate of potassium, hence the name *salt of tartar* now frequently applied to both the carbonates.

Sesquicarbonate of Potassium.—Under this name the "Eclectic" practitioners prescribe an alkaline powder prepared by dissolving bicarbonate in water and evaporating "by means of heat raised a very few degrees above the boiling point," till "sufficiently concentrated," the resulting precipitate is then dried by "a gentle heat." It is well ascertained that the bicarbonate of potassium loses CO_2 by an elevation of temperature, but it is nonsense to claim for it that as thus prepared it is a true sesquicarbonate. This powder is described as being permanent in dry air, while the ordinary carbonate is deliquescent. The synonym "vegetable caustic" applied to it in Dr. King's *Dispensatory* is more properly applied to caustic potassa, KHO.

Liquor Potassæ, U. S. P. (*Solution of Caustic Potassa.*)

	Reduced.
Take of Bicarbonate of potassium, fifteen troyounces	℥xv.
Lime, nine troyounces	℥ix.
Distilled water, a sufficient quantity.	

Dissolve the bicarbonate in four pints (reduced, f℥viij) of distilled water, and heat the solution until effervescence ceases. Then add distilled water to make up the loss by evaporation, and heat the solution to the boiling point. Mix the lime with four pints (reduced, f℥viij) of distilled water, and, having heated the mixture to the boiling point, add it to the alkaline solution, and boil for ten minutes. Then transfer the whole to a muslin strainer, and, when the liquid portion has passed, add sufficient distilled water, through the strainer, to make the strained liquid measure seven pints (reduced, f℥xiv). Lastly, keep the liquid in well-stopped bottles of green glass.

Solution of potassa, thus prepared, has the specific gravity of 1.065, and contains five and eight-tenths per cent. of hydrate of potassa.

An improved process, by John Abraham, of Liverpool, directs

that the carbonate of potassium be put into a stoneware vessel and the water added, then to boil, and then to add little by little the hydrate of lime, stirring during half an hour; after subsidence the solution may be poured off clear. A practical advantage is gained by adding the hydrate of lime to the alkaline solution, instead of *vice versa*.

Solution of potassa may also be prepared in the following manner:—

Take of Potassa, a troyounce (reduced, ʒss).
Distilled water, a pint (reduced, fʒj).

Dissolve the potassa in the distilled water, and allow the solution to stand until the sediment subsides. Then pour off the clear liquid and keep in well-stoppered bottles of green glass.

This preparation, by the first process as above, may be conveniently made with the apparatus ordinarily at hand. An evaporating dish and two beaker glasses, or salt-mouth bottles of sufficient size, and a strainer stretched over a frame or funnel are sufficient. The use of a strainer may be avoided by allowing the precipitated carbonate of calcium to subside, and drawing off the liquid with a siphon, or decanting it carefully.

The second process is chiefly resorted to extemporaneously, and by those who use but small portions; it is only satisfactory where the caustic potassa is of standard quality; as frequently found in drug stores, it is deteriorated by deliquescence and the absorption of carbonic acid.

This solution is a colorless liquid with an intensely acrid taste; sp. gr. 1.065. It should not effervesce with acids or precipitate when mixed with two or three measures of strong alcohol. Metallic impurities are detected as in the case of bicarbonate of potassium. It has a very strong affinity for carbonic acid, which it continually abstracts from the air. It attacks flint glass; hence the direction to keep it in green glass bottles. Its effect upon the skin is to produce an oily or soapy sensation, due to the destruction of the cuticle; it also destroys or greatly injures vegetable fibre.

Its use in medicine is chiefly confined to neutralizing free acid in the stomach and in the secretions. It is applied to the treatment of scrofulous and cutaneous affections, and to the arrest of the uric acid deposits in the urine. The dose is from ♏v to fʒss. When given internally, it should be *largely diluted with milk.* Dr. E. Wilson, of this city, has used it with success in a case of extreme obesity for reducing the accumulation of fat; by pushing the dose, diluted as above, to ♏xl three times a day, his patient, a female, lost 48 lbs. weight in a few months, so that from weighing 198 lbs. at the commencement of the treatment, she weighed only 150 lbs. at its close.

Potassa, U. S. P. (*Vegetable Caustic, Caustic Potassa, Hydrate of Potassa.* KHO.)

This preparation is made from the foregoing by evaporating it in an iron vessel to dryness, fusing it, and running it into moulds.

It is usually found in the shops of two qualities—one in sticks somewhat thicker than a quill, of a bluish-gray color and peculiar earthy odor; the other quite white, frequently thinner than the other, and more free from organic impurities. It is so deliquescent as to become moist on exposure for a few minutes to the air, and should be kept well and tightly closed; sometimes a few coriander seeds are placed with it in the bottle; they keep it dryer, and prevent its contact with the glass, upon which it acts.

It is a very powerful caustic, destroying the part to which it is applied, and producing a deep eschar. Its chief use is in opening abscesses, forming issues, etc. One of its chief disadvantages for these applications arises from its deliquescence, which occasions the spread of its corrosive influence to adjacent parts.

Potassa cum Calce, U. S. P.

Take of Potassa,
Lime, of each, a troyounce.

Rub them together into a powder, and keep the mixture in a well-stopped bottle. This powder is designed to be applied in the form of paste, made with a little alcohol, but by a modification of the process, a similar article is produced, which is run into sticks, and is found in the shops in that form, resembling common caustic in appearance. It is milder from the dilution with lime, and less deliquescent.

Potassii Acetas. (*Sal Diureticus.* $2K,\overline{Ac}+2H_2O$.)

Made by neutralizing acetic acid with bicarbonate of potassium. The potassa combines with the acetic acid, liberating the carbonic acid with effervescence; the process is completed by evaporating by a carefully regulated heat till it fuses and crystallizes, or dries into a powder. This preparation is difficult to prepare in perfection; the finest specimens found in this market are imported from France, in foliated satiny masses, unctuous to the touch, and of a pungent saline taste; it is neutral in its reactions, and extremely soluble and deliquescent, so much so as to be very difficult to manipulate with.

In medicine it is used as a diuretic, refrigerant, and alterative. Recently it is much prescribed in acute rheumatism. The acid it contains being consumed in passing through the system, the alkali is found as carbonate in the urine, which is much increased in quantity. The dose of acetate of potassium is from gr. x to ʒij.

Soluble in half its weight of water and in twice its weight of alcohol; the aqueous solution is without action on litmus. Metallic or earthy impurities are detected as in the case of bicarbonate of potassium; hyposulphurous acid is detected by the *gray* precipitate obtained with a solution of protonitrate of mercury; the pure salt affords a white precipitate.

The crystallized salt is expensive, and very liable to deteriorate by deliquescence, and when deliquesced is of variable state of hy-

dration, so that some pharmacists find it desirable to make the salt in concentrated solution, and dilute it as required. The following formula, by James T. Shinn, of Philadelphia, is adapted to this purpose:—

Take of Carbonate of potassium	4 ounces, 6 drachms.
Acetic acid	11½ ounces, or sufficient.

Add the acid gradually to the carbonate of potassium until effervescence ceases, and the liquid is neutral to test paper, and water sufficient to make a pint. Each fluidrachm of this solution contains half a drachm of acetate of potassium, and it may thus be "weighed by measure" to suit each prescription presented.

A recipe is given among the Extemporaneous Preparations for a ready mode of preparing acetate of potassium in a liquid form, suitable for use.

Potassii Citras, U. S. P. (*Citrate of Potassium.* $3K,\overline{Ci}$)

	Reduced.
Take of Citric acid, ℥x	℥x.
Bicarbonate of potassium, ℥xiv	℥xiv.
Water, q. s. (Oij)	f℥iv.

Dissolve the citric acid in the water, add the bicarbonate gradually, and when effervescence has ceased, strain and evaporate to dryness, stirring constantly after the pellicle has begun to form till the salt granulates, then rub it in a mortar (wedgewood), pass it through a coarse sieve, and put it in a bottle, which should be kept closely stopped. In this process, as in the foregoing, by single elective affinity the base combines with the acid, liberating the gaseous ingredient with effervescence. As citric acid of commerce varies in the precise quantity of water it contains, these proportions may be changed so as to insure complete saturation, though the presence of a slight excess of the acid is not objectionable. The potassium is here added in the full proportion to form a basic salt; there are, however, two other salts of citric acid and potassium having one and two equivalents of the base, respectively. The salt is a granular powder, soluble in twice its weight of water, from which alcohol precipitates a more concentrated solution, deliquescent, and in its effects refrigerant and diaphoretic. Its dose is from ℈j to ʒss.

Earthy and metallic oxides are precipitated by alkalies, sulphuretted hydrogen, and ferrocyanide of potassium; sulphuric and muriatic acids by salts of barium and silver; tartaric acid by the addition of muriatic acid.

Among the diaphoretic solutions, under the head of Extemporaneous Preparations, this salt in various liquid forms is again introduced.

Potassii Chloras. (*Chlorate of Potassium.* K,ClO_3.)

Chlorate of potassium may be prepared by passing chlorine gas into a solution of potassa or its carbonate; at first, chloride of potas-

sium and hypochlorite of potassium are formed; with these, a further proportion of chlorine produces changes resulting in the conversion of the hypochloric into chloric acid, which exists in combination with the potassa as chlorate of potassium; this is separated by crystallization from the more soluble chloride of potassium. There are modifications of this process by which a larger yield and greater economy of materials are produced. For a description of it, see 13th ed. *Wood and Bache's Dispensatory*, page 702. The process in use for commercial purposes consists in passing chlorine gas into a moistened mixture of three parts of chloride of potassium and ten of slaked lime until saturated, and well boiling the product. Chlorinated lime is first formed; this, on boiling with water, splits up into chloride of calcium and chlorate of calcium, and the latter, reacting on the chloride of potassium, yields chloride of calcium and chlorate of potassium, $Ca2ClO_3 + 2KCl = CaCl_2 + 2KClO_3$.

This salt is anhydrous. It appears in heavy crystals of a pearly lustre, sp. gr. 1.989. Its taste is cooling, sharp, resembling that of nitre; it readily fuses, enters into ebullition, and gives off oxygen, leaving as a residue, when the process is pushed to completion, chloride of potassium.

It is soluble in two parts of boiling and sixteen parts of cold water; is very explosive when mixed with inflammable substances (sulphur, charcoal, etc.). If dropped in concentrated HSO_4, the chloric acid of the salt is decomposed into hyperchloric and chlorous acids, which latter suddenly decomposes into chlorine and oxygen, thereby causing a violent explosion.

This property renders it necessary that pharmacists and those dispensing chlorate of potassium should remember that all substances in which carbon is loosely combined will produce the same result. Sugar, tannic acid, etc., when incorporated with one another, should always be powdered separately and mixed in a paper by means of a wooden spatula.

Its cold solution is not affected by any tests except such as produce precipitates with potassa (tartaric acid and chloride of platinum). The presence of saltpetre is detected by the alkaline reaction of the salt after having been exposed to a strong heat.

The uses of chlorate of potassium in the arts are as an oxidizing agent in calico printing, and in the fabrication of friction matches and explosive compounds.

In medicine, it is much prescribed as an alterative, diuretic, nervine, and antiseptic, and for its asserted effect as an oxidizer of the blood. The great variety of diseases to which it has been applied and its general popularity with the profession have, of late years, made it a leading article in the shop of the apothecary. It is asserted to be useful in treating diphtheria, a very prevalent and dangerous epidemic. It is mostly given in solution, and its sparing solubility is often quite overlooked by physicians; ʒss to fʒj of water is the limit of concentration. Chlorate of sodium is more soluble, and has been recommended as a substitute. The dose of chlorate

of potassium is from gr. x to ʒss; externally from ʒj to ʒiij to a pint of water as a urethral injection, mouth-wash, etc.

In tubercular affections it is highly recommended by some practitioners. Though considered as rather an innoxious remedy, it is capable of producing serious consequences in overdose, as shown in the case of Dr. Fountain, an esteemed physician of Davenport, Iowa, who had experimented with various doses, till, having exceeded half an ounce with impunity, he ventured upon one ounce at a dose, and fell a victim to his temerity.

Sodii Chloras. (*Chlorate of Sodium.* $NaClO_3$.)

By mutual decomposition of strong solutions of chlorate of potassium and bitartrate of sodium, bitartrate of potassium is precipitated while chlorate of sodium is retained in solution, from which it crystallizes on evaporation; the mother-liquor is best poured off from the first crystals formed, which are chiefly bitartrate of potassium; or the crystals are dissolved in the least possible quantity of cold water, so as to leave the crystals of cream of tartar behind.

It crystallizes in rhombohedrons, dissolves in alcohol, and in three parts of cold water, and is fusible, evolving some oxygen. It has been recommended as milder in its action than chlorate of potassium, and on account of its greater solubility.

The salt detonates when fused, if it contains tartaric acid.

Chlorate of sodium may be used in the dose of gr. xv to fʒss, in the cases for which chlorate of potassium is prescribed.

Phosphate of Potassium. $2KH_3PO_4$.

Of the three phosphates of potassium, that corresponding in composition to the ordinary phosphates of sodium and ammonium is the one used in medicine. It may be prepared by boiling glacial phosphoric acid, to change it into H_3PO_4, and then adding two equivalents of carbonate or bicarbonate of potassium, or by decomposing bone phosphate of lime with sulphuric acid as in the officinal process for phosphate of sodium, p. 187, and adding carbonate of potassium; the proper proportions are given below:—

Take of Bone, burnt to whiteness and powdered . . .	Ten parts.
Sulphuric acid	Six parts.
Bicarbonate of potassium	Sufficient.

Mix the powdered bone with the sulphuric acid, in an earthen vessel; then add ten parts of water, and stir them well together, digest for three days, occasionally adding a little water, and frequently stirring; then pour on ten parts of boiling water, and strain through linen; set by the strained liquid that the dregs may subside, from which pour off the clear solution, and boil it down to eight parts; to this add bicarbonate of potassium previously dissolved in hot water until effervescence ceases; filter and evaporate to dryness.

This salt is slightly acid to test paper, though called the neutral phosphate; it is white, amorphous, deliquescent, and freely soluble.

It has been given as an alterative in scrofula and phthisis in the dose of ten to twenty grains, and as an ingredient in some of the compounds used as tonics.

Hypophosphite of Potassium. KH_3PO_2.

This salt is prepared from the hypophosphite of calcium and carbonate of potassium, which decompose each other, yielding hypophosphite of potassium and insoluble carbonate of calcium which is separated. The proportions are as follows:—

Take of Hypophosphite of calcium	6 oz.
Granulated carbonate of potassium	$5\frac{3}{4}$ oz.
Water	Sufficient.

Dissolve the hypophosphite in a pint and a half and the carbonate in half a pint of water. Mix the solutions, and separate the carbonate of calcium on a filter; after draining, pass water through the precipitate till it ceases to dissolve out the soluble salt; then evaporate, stirring toward the last to granulate the salt.

Hypophosphite of potassium is a white, opaque, deliquescent salt, very soluble in water and alcohol Its greater tendency to absorb moisture renders it less eligible for prescription than the sodium salt. Its dose is from three to five grains, and it enters into a number of the syrups of the mixed hypophosphites, though rarely prescribed separately.

Potassii Silicas.—The several kinds of glass are mixed silicates: those of sodium and calcium constitute window glass; potassium and calcium, crown glass, and potassium and lead, flint glass. It is, however, remarkable that the alkaline silicates by themselves are soluble in water and decomposable by acids; this solubility is increased by excess of alkali and by heat, especially by superheated steam.

Silicate of potassium is a transparent, vitreous mass, deliquescent and soluble in water; it is formed by fusing together silica and carbonate of potassium. Soluble glass is now manufactured on a large scale in Philadelphia, for use as an impervious coating to casks, as an ingredient in soaps, and for many economic uses. It has been asserted to be a powerful solvent for arthritic calculi composed of urate of sodium; the dose is ten to fifteen grains twice daily, dissolved in much water.

Potassii Picras, vel Carbazotas, Picrate of Potassium.—This salt is obtained by neutralizing picric acid with potassa or its carbonate, and crystallizing from hot water. It appears in fine yellow needles of a persistent bitter taste, which are insoluble in alcohol, not very soluble in cold water, requiring 260 parts at 60° F., but dissolves with facility in boiling water; it contains no water of crystallization. It has been used by Braconnot as a substitute for quinia in intermittent fevers, with good success; the dose is stated to be from two to five grains, in pills or powders on account of its sparing solubility; great care should be observed in rubbing the salts of this acid to powder, as they explode when struck with violence.

Group 3.—*Alkaline Salts, starting with Common Salt.*

Sodii chloridum, NaCl. Obtained by evaporation of certain natural spring waters.
Sodii sulphas, $Na_2SO_4,10H_2O$. By action of sulphuric acid on common salt.
Sodii carbonas, $Na_2CO_3.10H_2O$. By calcining the sulphate with carbon, chalk, etc.
Sodii carbonas exsiccat, Na_2CO_3. By simple calcination of carbonate.
Liquor sodæ, NaHO+aqua. By boiling the carbonate with lime; sp. gr. 1.071.
Soda, NaHO. By evaporating the last mentioned solution.
Sodii bicarbonas, $2NaHCO_3$. By passing gaseous CO_2 into a box containing effloresced crystals of the carbonate.
Sodii phosphas, $Na_2HPO_4,12H_2O$. By neutralizing superphosphate of calcium with carbonate of sodium, filtering, and evaporating.
Sodii hypophosphis, Na_2HPO_2. By precipitating hypophosphite of calcium with Na_2CO_3.
Liquor sodæ chlorinata. By treating the carbonate in solution with chlorinated lime.
Sodii hyposulphis, $Na_2S_2O_3,5H_2O$. From sulphur and carbonate of sodium by combustion, etc.
Sodii acetas, $Na\overline{Ac}$. An intermediate salt in the preparation of acetic acid.
Sodii citras, $Na_3\overline{Ci}$. By saturating citric acid with Na_2CO_3.
Liquor sodii tartro-citratis. By combining bicarbonate of sodium with $\overline{T}$ and $\overline{Ci}$.
Sodii valerianas, $Na,\overline{Va}$. An intermediate salt in the preparation of other valerianates.
Sodii benzoas, $Na\overline{Bz}$. By neutralizing benzoic acid with $NaCO_3$.
Sodii sulphovinas, NaC_2H_6,SO_4. From sulphovinate of barium with $NaCO_3$.
Ammonii benzoas, $NH_3\overline{Bz}$. By saturating benzoic acid with water of ammonia and evaporating.

Sodii Chloridum. (*Common Salt.* NaCl = 58.5.)

Common salt is a native mineral substance found in various parts of the world, and, in solution, a constituent of numerous springs, from which it is readily obtained by evaporation. It is also one of the products of the evaporation of sea-water.

It is found, in commerce, in crystals called rock salt, or usually in a granulated or fine dry powder. It is soluble in about three parts of water; nearly insoluble in alcohol, and contains no water of crystallization; its chief use, that of a condiment and antiseptic, is well known. It is an emetic in large doses; externally stimulant. Salt-baths, with or without friction, are useful appliances of the physician.

Tests.—Adulterations with lime or magnesia are shown by a precipitate with carbonate of sodium; metallic salts by sulphuretted hydrogen or ferrocyanide of potassium; sulphates by a barium salt.

Sodii Sulphas. (*Glauber's Salts.* $Na_2SO_4,10H_2O = 322$.)

It is produced from the residuum in making muriatic acid and chlorinated lime, and is one of the most abundant and cheap articles of chemical manufacture. It exists in sea-water, and in many spring waters. It is usually in very large white efflorescent crystals. Neutral, very soluble, with a bitter, nauseous, and saline taste; its composition is two equivalents of sodium, one of sulphuric acid, and ten of water; the water, which forms 55 per cent. of its weight, is nearly all lost in effloresced specimens. Its dose, as a cathartic, is ʒss to ʒj (one-half when effloresced), though chiefly used as a purge for horses in much larger quantities. It is the principal ingredient in the so-called Cheltenham salts. It has been prescribed in doses of ʒss in dysentery.

The presence of chlorides may be detected by nitrate of silver, of metallic salts as above. It is not often adulterated.

Sodii Carbonas. (*Sal Soda. Washing Soda.* $Na_2CO_3,10H_2O=286$.)

Carbonate of sodium is found native, and is also extracted from the ashes of sea plants, in which case it is called barilla, or kelp; it is, however, chiefly produced on a very large scale by calcining sulphate of sodium with small coal and chalk, which, by the abstraction of oxygen, reduces it into sulphuret, and then from the presence of the chalk into carbonate of sodium and sulphuret of calcium, $Na_2S + CaCO_3 = CaS + Na_2CO_3$. The carbonate is separated by digestion with hot water, evaporated, further carbonated, redissolved, and crystallized.

The chief use of carbonate of sodium is in the arts and in domestic economy as a detergent, and in the preparation of numerous officinal and other carbonates and salts of sodium. It is extremely soluble in water, and efflorescent, and contains 62 per cent. of water of crystallization, which may be dissipated by heat.

The presence of common salt is detected by supersaturating with nitric acid and adding solution of nitrate of silver; sulphate of sodium by solution of nitrate of barium. It is not commonly adulterated. Dose, as an antacid, gr. x to ʒss.

Sodii Carbonas Exsiccata. (*Dried or Calcined Carbonate of Sodium.* $Na_2CO_3=106$.)

Take of Carbonate of sodium, a convenient quantity.

Expose it to a heat in a clean iron (or porcelain) vessel until it is thoroughly dried, stirring constantly with an iron (or porcelain) spatula, then rub into powder.

This is the form in which carbonate of sodium is most conveniently given in powder or pill. It is a milder antacid than the corresponding salt of potassium. The dose of dried carbonate of sodium is gr. v to xv. It enters into the composition of some tonic and antacid pills.

Liquor Sodæ, U. S. P. NaHO in Aq.

Take of Carbonate of sodium, twenty-six troyounces.
Lime, eight troyounces.
Distilled water, a sufficient quantity.

Dissolve the carbonate in three pints and a half of distilled water, and heat the solution to the boiling point. Mix the lime with three pints of distilled water, and, having heated the mixture to the boiling point, add it to the solution of the carbonate, and boil for ten minutes. Then transfer the whole to a muslin strainer, and, when the liquid portion has passed, add sufficient distilled water, through the strainer, to make the strained liquid measure six pints. Lastly, keep the liquid in well-stopped bottles of green glass.

Solution of soda has the specific gravity 1.071, and contains five and seven-tenths per cent. of hydrate of sodium.

A colorless liquid, having an extremely acrid taste, and a strong alkaline reaction. It causes no effervescence when added to a diluted acid, and yields no precipitate with bichloride of platinum. When saturated with diluted nitric acid, it gives no precipitate, or only a slight one, with carbonate of sodium, chloride of barium, or nitrate of silver.

This is a new officinal in the *Pharmacopœia* of 1860, in which it is placed under the general head Liquores. In the process and rationale it scarcely differs from solution of caustic potassa. The carbonate of sodium of commerce is considered of sufficient purity to yield on the abstraction of the carbonic acid a solution of caustic soda, adapted to medicinal and ordinary chemical uses. Its employment in medicine will be as an antacid and antilithic; it is well adapted to replace solution of potassa, being somewhat milder in its action. Dose, ♏v to ʒss, largely diluted with milk.

Soda. (*Caustic Soda.* NaHO = 40.)

Hydrate of caustic soda is prepared from its solution precisely like caustic potassa; it is seldom used in medicine, but is employed in some chemical operations, where the presence of potassa is not admissible, and in the manufacture of hard soaps. Under the name of *concentrated lye* this form of alkali has been introduced into commerce in small iron boxes for domestic use.

Sodii Bicarbonas. (*Supercarbonate of Sodium.* $Na,HCO_3 = 85$.)

The best process for preparing this salt is a modification of that originally proposed by Dr. Franklin R. Smith, of Bellefonte, Pa. The crystallized carbonate partly effloresced, or a mixture of the crystallized and dried, in proper proportion, is placed in a wooden perforated box, and carbonic acid gas (generated by the action of dilute sulphuric acid on marble) is passed into it. Owing to the strong affinity of the monocarbonate for a further dose of carbonic acid, the bicarbonate is generated in this simple way. Another process consists of stirring together chloride of sodium, dissolved in three times its weight of water, and carbonate of ammonium, which has chiefly passed into bicarbonate—equal weights; the two salts decompose each other, producing bicarbonate of sodium, which is sparingly soluble and precipitates in crystalline grains, and muriate of ammonium, which remains in solution, NH_4HCO_3 and $NaCl = NaHCO_3$ and NH_4Cl. As met with in the shops, bicarbonate of sodium is a dry, white powder, slightly alkaline, permanent in the air, soluble in thirteen parts of cold water, decomposed by a boiling temperature. The commercial article I have generally found to contain some sesqui- or monocarbonate. The taste betrays this, as also the fact of its readily precipitating carbonate of magnesium from a cold solution of Epsom salts, which well-made bicarbonate will not; also the formation of a reddish precipitate with

corrosive sublimate. This impurity, the result of defective preparation, although not very important, renders this remedy less agreeable, and, in view of its employment in effervescing powders, etc., less effective. The proportion of carbonic acid given off from bicarbonate of sodium by treating it with acids exceeds 50 per cent., so that it is one of the most productive articles for this purpose. It enters into effervescing soda, Seidlitz, yeast, and some other powders, in which tartaric acid is employed to decompose it; the proportion being thirty-five parts of the acid to forty of the bicarbonate.

Sodium saleratus is now employed in immense quantities as an adulteration of the proper saleratus, and as a substitute for bicarbonate of sodium; it is, generally, an imperfect substitute for the officinal bicarbonate of sodium.

Bicarbonate of sodium is used in medicine as a mild antacid; it is very cheap, though, I think, inferior to bicarbonate of potassium for the purpose. Dose, ℈j to ʒj, in carbonic-acid water if at hand.

(For effervescing powders, *see* Extemporaneous Prescriptions.)

Sodii Bicarbonas. Bicarbonate of Sodium, U. S. P. ($NaHCO_3$.)

Take of Commercial bicarbonate of sodium, in powder, 64 troyounces.
Distilled water, six pints.

Introduce the powder into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour the water gradually upon it. When the liquid has ceased to drop, or when the washings cease to precipitate a solution of sulphate of magnesium, remove the bicarbonate of sodium from the percolator, and drop it on bibulous paper in a warm place.

This is a new officinal in the last edition of the *U. S. Pharmacopœia*, and is much to be preferred for medicinal uses to the commercial article; the tests above given for the commercial article are appropriate to this.

Sodii Phosphas. Phosphate of Sodium, U. S. P. (Na_2HPO_4,$12H_2O$.)

Phosphate of sodium is formed by digesting bone-ash (phosphate of calcium) in sulphuric acid, thus liberating phosphoric acid. The superior affinity of sulphuric acid for the lime causes them to unite at the expense of the phosphoric acid, which is thus liberated; the sulphate of calcium being separated, carbonate of sodium is added to the phosphoric acid till neutralized, and by crystallizing, the pure phosphate of sodium is produced in large, transparent, efflorescent crystals.

It is a tribasic salt, consisting of one equivalent of phosphoric acid, two of soda, and one of water, and twelve of water of crystallization. The enormous proportion of water, 62.3 per cent. of its weight, is a remarkable property of this salt.

It dissolves in four times its weight of cold water, and fuses in its water of crystallization when moderately heated. It is insoluble in alcohol. The solution has an alkaline reaction, and does not effervesce with acids.

The precipitates with nitrate of silver (yellow), chloride of barium, and acetate of lead are all soluble in nitric acid. The presence of lime is found by a white precipitate with oxalate of ammonium.

Sometimes it contains arseniate of sodium, which is detected by saturating the solution with gaseous sulphuretted hydrogen, heating slightly, and afterwards carefully adding pure phosphoric acid, when sulphuret of arsenic will be precipitated.

Phosphate of sodium is a mild saline cathartic and diuretic. Dose, from ʒij to ʒj, and is chiefly recommended by its taste, which resembles that of common salt.

Hypophosphite of Sodium. Na_2HPO_2.

This is prepared by double decomposition between hypophosphite of calcium and crystallized carbonate of sodium.

Take of Hypophosphite of calcium	6 oz.
Crystallized carbonate of sodium . .	10 oz.
Water	A sufficient quantity.

Dissolve the hypophosphite in four pints of water, and the carbonate in a pint and a half, mix the solutions, pour the mixture on a filter, and lixiviate the precipitate of carbonate of calcium, after draining, with water, till the filtrate measures six pints. Evaporate this liquid carefully till a pellicle forms, and then stir constantly, continuing the heat till it granulates. In this state the salt is pure enough for medical use; but, if desired in crystals, treat the granulated salt with alcohol sp. gr. .835, evaporate the solution till syrupy, and set it by in a warm place to crystallize.

Hypophosphite of sodium crystallizes in rectangular tables with a pearly lustre, is quite soluble in water and in ordinary alcohol, and deliquesces slightly when exposed to the air. It is given with the other salts of hypophosphorous acid as a tonic, especially applicable to phthisis. Dose, 5 grains three times a day.

Liquor Sodæ Chlorinatæ, U. S. P. (*Labarraque's Disinfecting Solution.*)

	Reduced.
Take of Chlorinated lime, twelve troyounces	ʒj.
Carbonate of sodium, twenty-four troyounces	ʒij.
Water, twelve pints.	Oj.

Dissolve the carbonate of sodium in three pints of the water, with the aid of heat. Triturate the chlorinated lime, a little at a time, with small portions of the water, gradually added, until a smooth, uniform mixture is obtained. Mix this intimately with the remainder of the water, and set the mixture aside for twenty-four hours. Then decant the clear liquid, and, having transferred the residue to a muslin strainer, allow it to drain until sufficient liquid has passed to make, with the decanted liquid, eight pints. Mix this thoroughly with the solution of carbonate of sodium, transfer the mixture to a muslin strainer, and allow it to drain, adding water, if necessary, towards the close, until eleven pints and a half of liquid have passed. Lastly, keep the liquid in well-stopped bottles, protected from the light.

The necessity for the aid of heat in dissolving the carbonate of sodium may be overcome by the use of the mortar and pestle, as directed in the chapter on Solutions. The solution of the chlorinated lime is conveniently accomplished by mixing it with some clean sand and packing it rather loosely into a funnel with a pledget of cotton in the neck, then pouring the water upon it. In the absence of a precipitating jar in which to mix the solutions, wide-mouthed bottles may be substituted, being well adapted to allow the precipitated carbonate of lime to subside.

Labarraque's is a transparent liquid, of a greenish-yellow color, having a slight odor of chlorine, and a sharp, saline taste. Its specific gravity is 1.045; it contains an excess of carbonate of sodium. Its value will be chiefly dependent on the quality of the chlorinated lime used; if this is moist and has a faint odor, it will make inferior Labarraque's solution. It rapidly decolorizes solution of indigo, and produces a copious, light-brown precipitate with solution of sulphate of iron. It owes its therapeutic and antiseptic properties to containing hypochlorous acid, which is readily liberated on the addition of even a weak acid, and, on exposure to the air, by the absorption of carbonic acid. It is used in malignant fevers as an antiseptic and stimulant, and to correct fetid eructations and evacuations; it is a favorite addition to gargles in ulcerated sore-throat. One of its principal uses is to purify the air in sick-rooms, in which case it acts by decomposing sulphuretted hydrogen, against which gas, when inhaled, it is also an antidote. The dose is f℥ss, diluted with water or mucilage. In gargles, f℥ss or f℥j may be used in Oss.

A demand for this solution has grown out of the now fashionable art of skeletonizing and bleaching leaves and seed-vessels of plants. A solution of chloride of lime serves a good purpose for bleaching skeletonized plant structures which are deprived of their chlorophyl, but for ferns, which are to be bleached without any previous process, solution of chlorinated soda has been found greatly superior.

Sodii Hyposulphis. (*Hyposulphite of Sodium.* $Na_2S_2O_3,5H_2O=248$.)

This salt, which is very extensively used by photographers for the solution of the unaltered iodide of silver, may be economically prepared by the following process: 16 oz. finely-powdered crystallized carbonate of sodium are mixed with 5 oz. flowers of sulphur, and heated in a porcelain dish with constant agitation, until it takes fire and burns to sulphite of sodium; this is dissolved in water and boiled with sulphur, by which another equivalent of this element is taken up, so as to form the hyposulphite $Na_2 + SO_3 + S = Na_2S_2O_3$; it is then evaporated to crystallization.

The crystals are large, colorless, rhombic prisms, of a cooling, afterwards bitterish, somewhat alkaline, sulphurous taste, and easily soluble in water; the solution gradually deposits sulphur, leaving sulphite of sodium, or if in contact with the air, sulphate of sodium, in solution.

It has been recommended in various diseases as a resolvent, alterative, and sudorific, and also as a solvent for biliary concretions; ʒss to ʒj of it is given in the course of a day in solution or preferably in syrup. Externally it has been employed as a bath in quantities of from 1 to 4 ounces dissolved in the necessary quantity of water, and with the subsequent addition of 3 fluidounces of diluted sulphuric acid for each ounce of the salt, so as to liberate the hyposulphurous acid which immediately decomposes into sulphur and sulphurous acid.

Sodii Acetas. $Na,\overline{Ac} + 3Aq. = 160.$

This is officinal in the list, being formed by double decomposition between acetate of calcium obtained by neutralizing the acid from the destructive distillation of wood, with carbonate of sodium, as explained under the head of Acetic Acid. It is made officinal with a view to the preparation of acetic acid by its decomposition; it is also made as follows:—

Acetate of lead is decomposed by carbonate of sodium, a precipitate of carbonate of lead is formed, and the acetate of sodium remains in solution; or such a solution is obtained by neutralizing acetic acid with carbonate of sodium; it is then evaporated to crystallization. The salt crystallizes in prisms of a saline, bitter taste, which effloresce in warm dry weather, and are fusible and very soluble in water.

It has been used for the same purpose for which acetate of potassium is employed, and is said to be rather milder in its action; the dose is ʒj to ʒij.

Metals are detected in the solution of this salt by sulphuretted hydrogen and ferrocyanide of potassium; sulphuric acid (sulphate of sodium) by the characteristic precipitate with acetate of barium.

Sodii Citras. (*Citrate of Sodium.* $Na_3\overline{Ci} = 276.$)

Citric acid being a tribasic acid furnishes three salts with sodium, of which the most desirable appears to be that, the composition of which is given above. It is easily made by adding two equivalents of bicarbonate of sodium to one of citric acid, evaporating, and crystallizing. These proportions would indicate approximately one ounce of bicarbonate of sodium to ten drachms of citric acid. It forms needles of a pleasant sub-acid taste. If the basic citrate is prepared the proportion of bicarbonate should be increased to one ounce and a half, and the salt would then correspond more nearly with the officinal citrate of potassium. Its taste is free from bitterness, and it is recommended as a pleasant saline cathartic. Dose, six to twelve drachms.

Solution of Tartro-Citrate of Sodium.

Tartro-citrate of sodium has been recommended, in solution, as furnishing a more permanent and cheaper purgative lemonade than

the justly celebrated citrate of magnesium. I have had but little experience with it, but propose the following as a practicable formula for its preparation:—

Take of	Tartaric acid	ʒvj.
	Bicarbonate of sodium	ʒvss or q. s.
	Water	fʒxss.

Dissolve the acid in the water, and add the sodium salt till it is nearly neutral, then filter and add—

Simple syrup	fʒiss.
Tincture of fresh lemon peel	fʒss.

And lastly—

Citric acid,	
Bicarbonate of sodium, of each	ʒj.

Cork and bottle immediately and securely. Dose, one bottle, as a cathartic.

Sodii Citro-Tartras Effervescens, Ph. Br.

Take of	Bicarbonate of sodium	17 parts.
	Citric acid	6 parts.
	Tartaric acid	8 parts.

Mix them and heat to 200 to 220° until the particles aggregate to a granular condition. It should be kept in well-closed bottles.

Sodii Valerianas. $NaC_5H_9O_2 = 124.3$.

Valerianate of sodium is made by saturating solution of caustic soda with valerianic acid, as produced by the distillation of amylic alcohol or fusel oil from a mixture of sulphuric acid and bichromate of potassium, by which it is converted into valerianic acid, which combines with the soda. The valerianate is obtained dry by evaporation and fusion, and being broken, is in soft white crystalline pieces, very soluble, deliquescent, with the odor of valerianic acid, and a taste at first styptic and afterwards sweetish; it melts without loss at 285°, and concretes on cooling. If 100 grains of the salt, dissolved in 600 grains of water heated to 200°, be mixed with a solution of 100 grains of sulphate of zinc in the same quantity of water, crystals of valerianate of zinc will be formed on the surface of the mixture before it cools. Its use is to prepare the other valerianates by double decomposition. It should be soluble in absolute alcohol. (*See* Acidum Valerianicum.)

Sodii Sulphovinas. $NaC_2H_6,SO_4 + 2Aq$.

Sulphovinate of sodium is prepared by mixing about equal parts of concentrated sulphuric acid and strong alcohol, and heating afterwards by means of a water-bath; water is then added, and carbonate of barium to saturation; the solution of sulphovinate of barium is then exactly decomposed by a solution of sulphate of sodium, and the filtrate evaporated to crystallization. It crystallizes in hexagonal tables, is deliquescent and very soluble in water; it fuses at

187°, and is decomposed above 212°; its taste is pleasantly saline and sweet.

This salt has been recommended for delicate constitutions afflicted with weakness of the digestive organs and flatulency. The dose, as a laxative, is from half an ounce to one ounce.

The impurities might be barium, detected by sulphuric acid, or sulphate of sodium, detected by chloride of barium.

Sodii Benzoas. (*Benzoate of Sodium.* $Na,\overline{Bz} = 144.$)

If benzoic acid is saturated with carbonate of sodium, the solution yields, on evaporation and cooling, needles, which are little soluble in alcohol. It has been recommended in cases of gout on account of benzoic acid being changed by the animal economy into hippuric acid.

Group 4.—*Alkaline Salts, starting with Crude Tartar.*

Crude argols, or tartar. Deposited in the casks during the refining of wines.

Potassii bitartras, $KH\overline{T}$. Purified by repeated crystallization, etc.

Potassii et sodii tartras, $KNa\overline{T} + 4H_2O$. Boiling carb. sodium with bitartrate.

Potassii tartras, $K_2\overline{T}$. Boiling pure carbonate potassium with bitartrate.

Potassii et boracis tartras, $KNa\overline{T} + 2KHBO_3\overline{T} + 2Aq$. Boiling borax with bitartrate; deliquescent.

Potassii boracico-tartras, $KHBO_3\overline{T}$. Boiling boracic acid with bitartrate; permanent.

Crude argols are imported from the wine-producing countries of two kinds, the red and the white tartar of commerce. Recently tartar has been produced, though not in large quantities, in the vicinity of Cincinnati, Ohio. It consists of potassa combined with an excess of tartaric acid, some tartrate of calcium, coloring matters, etc., the lees and settlings of the wine which have separated during the conversion of the sugar of the grape-juice into alcohol, and collected as a mass on the bottom and sides of the casks.

Potassii Bitartras. (*Cream of Tartar.* $KH\overline{T} + H_2O = 207.1.$)

Cream of tartar is made by treating argols with hot water, mixing with clay, which absorbs the coloring matters, purifying by crystallization, and reducing to powder. It is a white somewhat gritty powder, of an agreeable acid taste, sparingly soluble in the mouth, soluble in 184 parts of cold water, and in 18 parts of boiling water, which deposits it on cooling. It consists of one equivalent of potassium, one of water, and one of tartaric acid, though formerly considered, as its name implies, a bitartrate; the combined water contained in it is capable of being replaced by other bases, as in the two salts which follow, and in the tartrate of iron and potassium, and the tartrate of antimony and potassium, described in subsequent chapters. The reader is referred to page 75, 40th vol., *American Journal of Pharmacy*, for another and more efficient method of purifying cream of tartar and its derivatives, by Prof. E. S. Wayne, of Cincinnati.

Cream of tartar in doses of ℥ss to ℥j, and in smaller quantities, is a very common and well-known hydragogue cathartic, refrigerant, and diuretic. It is usually given diffused in water, being sparingly soluble.

Tests.—It is very liable to adulteration, which may be detected by its solubility as above, and by the following tests:—

It should be completely soluble in liquor potassæ and liquor ammoniæ.

Tartrate of calcium, which should not exceed five per cent. in a commercially pure specimen, is discovered in the neutralized solution by a white precipitate with phosphate of sodium, or neutral oxalate of ammonium.

Sulphuric acid, sulphate of calcium, alum, and sulphate of potassium by an insoluble precipitate, in cold solution, with chloride of barium.

Metals (copper, iron, etc.), by precipitates with sulphuretted hydrogen and ferrocyanuret of potassium.

Potassii et Sodii Tartras. (*Rochelle Salt.* $KNa\overline{T} + Aq. = 283.1$.)

Rochelle salt is prepared by combining one equivalent of carbonate of sodium with one of bitartrate of potassium. The sodium of the carbonate uniting with the excess of tartaric acid of the bitartrate to form a neutral salt, carbonic acid is evolved. The crystals of this salt are usually large, transparent, slightly efflorescent, of a saline not very unpleasant taste, and soluble in five parts of water. It is incompatible with most acids and acidulous salts, which by combining with the sodium throw down bitartrate of potassium. It is commonly sold in powder, and combined with one-third its weight of bicarbonate of sodium constitutes the so-called Seidlitz mixture. It is a mild and pleasant purgative. Dose, from ʒij to ℥j.

Tests.—The presence of tartrate of calcium, except in small quantity, renders the solution, in 2½ to 3 parts of cold water, milky.

Lime, metals, and sulphuric acid are detected as in cream of tartar; in the latter case, after acidulating with nitric acid.

Potassii Tartras. (*Soluble Tartar.* $K_2\overline{T} = 227.2$.)

Soluble tartar is a salt in which the excess of tartaric acid in bitartrate of potassium is combined with potassium; by boiling one equivalent of the carbonate of that alkali with one equivalent of bitartrate, the carbonic acid escapes; the reaction closely resembles that last described, substituting potassium for sodium. Tartrate of potassium is either in white crystals, or a granulated powder slightly deliquescent and freely soluble; it is less agreeable to the palate than the foregoing, which it resembles in medical properties and uses. The dose is from ʒj to ℥j.

Tests.—A solution in 2 parts cold water shows the presence of tartrate of calcium if milky.

Lime is detected by phosphate of sodium or neutral oxalate of ammonium.

Metals (iron, copper, tin), by ferrocyanide of potassium and sulphuretted hydrogen, the latter after acidulating with muriatic acid.

Sulphuric and muriatic acids are found in the solution acidulated with nitric acid by the precipitate with nitrate of barium and nitrate of silver.

Potassii et Boracis Tartras. $KNa\overline{T}+2(KHBO_3\overline{T})+3Aq.$

The *tartarus boraxatus* of the *German Pharmacopœias* is prepared by dissolving 3 parts of crystallized pure cream of tartar in a solution of 1 part borax in 5 parts water, and evaporating with constant agitation to dryness. It is soluble in 2 parts of water, deliquescing in the air, and has a mild, agreeably sour taste. Its medicinal properties are similar to those of the other neutral tartrates.

In its solution metallic oxides, lime, and mineral acids are detected as above.

Potassii Boracico-Tartras. $KHBO_3\overline{T}$.

The *tartarus boraxatus*, or *tartras borico-potassicus*, of the *French Codex*, as originally made by Soubeiran, is prepared by dissolving 1 part of boracic acid and 4 of cream of tartar, in 24 parts of water, and evaporating to dryness at or near the boiling point, so as to prevent the premature separation of the excess of bitartrate of potassium. The salt resembles the foregoing in appearance and properties, except that it keeps in the air without attracting moisture.

Borax in solution precipitates the mucilage of gum Arabic, Iceland moss salep, etc.; it colors curcuma paper brown, and dissolves in 2 parts boiling, and 12 cold water. Moistened with HSO_4, it colors the flame of alcohol green.

GROUP 5.—*Alkaline Salts—Preparations of Ammonia.*

Ammonii chloridum (Ammoniæ murias, 1860), $NH_3HCl = NH_4Cl$. Neutral, odorless, much used in the arts.

Ammonii chloridum purificatum. Made by purifying the commercial NH_4Cl.

Ammonii sulphas, $(NH_4)_2SO_4$. Manufactured from gas liquors.

Ammonii et magnesii sulphas. A constituent of the H_3BO_3 lagoons in Tuscany.

Ammonii phosphas, $2NH_4PO_4$. By precipitating phosphate calcium with carbonate of ammonium.

Ammonii hypophosphis, $NH_4H_2PO_2$. By precipitating hypophosphite of calcium with carbonate of ammonium.

Ammonii nitras, NH_4,NO_3. By heat furnishes N_2O.

Aqua ammoniæ. Aqueous solution of caustic ammonia, sp. gr. .960.

Aqua ammoniæ fortior. Aqueous solution of caustic ammonia, sp. gr. .900.

Spiritus ammoniæ. Alcoholic solution of caustic ammonia, sp. gr. .831.

Spiritus ammoniæ aromaticus. Alcoholic solution of carbonate of ammonium with aromatics.

Ammonii carbonas, $(NH_4)_2HCO_3$. Hard, translucent, pungent.

Ammonii bicarbonas, NH_4HCO_3. White, pulverulent, odorless.

Liquor ammonii acetatis. Neutral and mild solution of $4NH_4\overline{Ac}$.

Ammonii citras, $3NH_4\overline{Ci}$. In solution a diuretic.

Ammonii valerianas, $NH_4\overline{Va}$. Antispasmodic. Used in solution.

Ammonii sulphuretum, NH_4HS. Test liquids forming sulphurets of metals.

Ammonii benzoas, $NH_4\overline{Bz}$. Used in gout.

Ammonii Chloridum. (*Ammoniæ Murias*, 1860. $NH_4Cl = 53.5$.)

Muriate of ammoniac, *sal ammoniac*, or *chloride of ammonium* is in the list of the *Pharmacopœia;* it is prepared on a very large scale in England from the residuary products of the destructive distillation of coal, and from other empyreumatic products containing ammonium. It is in white, translucent, fibrous masses, which are convex on one surface and concave on the other; it has a pungent saline taste, but no odor. It cannot be conveniently powdered by contusion or trituration, and is best reduced, in a small way, by dissolving, evaporating, and granulating at a moderate heat. It is a very soluble salt, being dissolved by less than three parts of cold water, and in alcohol; it is incompatible with strong acids, which liberate muriatic acid, and with alkalies, which disengage ammonia, as in some of the processes which follow. It is frequently prescribed, especially by German practitioners, as a stimulating alterative in catarrhs, combined with expectorants. Dose, from gr. v to xx.

Tests.—The reactions of ammonia are similar to those of potassa; bichloride of platinum produces a yellow precipitate; tartaric acid a crystalline white precipitate, which is somewhat more soluble than cream of tartar.

The characteristic test to distinguish its salts from the potassium salts, is the evolution of ammonia on triturating them with hydrated lime, or with caustic potassa; ammonia is recognized by its peculiar odor and the white fumes occasioned on the approach of a rod moistened with muriatic acid. The salts of ammonia, except those with fixed mineral acids, are volatilized by a red heat.

Muriate of ammonia should be perfectly white, and entirely dissipated by heat. Copper, lead, and tin are detected by sulphuretted hydrogen; iron by ferrocyanide of potassium; sulphuric acid by chloride of barium.

Ammonii Chloridum Purificatum.

Take of Chloride of ammonium, in small pieces, twenty troyounces.
Water of ammonia, five fluidrachms.
Water, two pints.

Dissolve the chloride of ammonium in the water, in a porcelain dish, with the aid of heat; add the water of ammonia, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring, at a moderate heat, until it granulates.

It is soluble in $2\frac{1}{2}$ parts of cold and its own weight of boiling water, has a faint acid reaction, and is not discolored by tannic acid.

Ammonii Sulphas. $(NH_4)_2SO_4 = 75$.

This salt, which is seldom met with in the shops, is now manufactured on a large scale both in Philadelphia and in New York, from the washings of coal gas. It is a very soluble salt, chiefly produced from the otherwise useless residuary liquids obtained from

the gas works, and is chiefly consumed in the manufacture of ammonia alum and of ammonia on a large scale. It is also available for the preparation of carbonate of ammonium and the solutions of caustic ammonia, though it is said to impart to these products a more empyreumatic odor than the muriate.

Ammonii et Magnesii Sulphas. NH_4,SO_4+Mg,SO_4+6Aq?

This is a new commercial source of the preparations of ammonia, derived from the boracic acid lagoons in Tuscany. It crystallizes out of the solutions formed in the purification of the boracic acid in England. This double sulphate is readily made available in the preparation of the salts of ammonium, and is said to yield products devoid of the empyreumatic odor so perceptible in the ammonium salts obtained from the gas liquor products.

Ammonii Nitras. $NH_4,NO_3=80$.

Nitric acid is saturared with carbonate of ammonium and evaporated. It occurs in prisms, which are deliquescent, and have a cooling saline taste.

If thrown in a red-hot crucible it burns with a yellow flame, and has, therefore, received the name of *nitrum flammans.* When not too suddenly heated, it is decomposed exactly into $2H_2O$ and N_2O —oxide of nitrogen, or "laughing gas."

It is given in similar complaints with saltpetre and nitrate of sodium, in doses ranging from 10 grains to 2 scruples.

Aqua Ammoniæ, U. S. P. (*Preparations*), *and Aqua Ammoniæ Fortior*, U. S. P. (*List*).

Solution of ammonia (spirits of hartshorn) *and stronger solution of ammonia* are obtained from chloride of ammonium by the action of quicklime, which, combining with the acid, liberates the caustic alkali in the form of gas, $NH_4Cl + CaO = NH_3HO + CaCl$. The gas is passed by suitable contrivances into water, which absorbs it with avidity, especially if refrigerated.

The usual commercial strength is somewhat below that of the officinal *aqua ammoniæ*, which has the sp. gr. 960. The strongest marks 900, and contains twenty-six per cent. of the gas. It should be handled with great caution in warm weather, serious accidents being liable to occur from its sudden and violent effervescence. Both of these preparations are used externally, the latter rarely, in various combinations for immediate vesication. They are too caustic to be given by the stomach unless largely diluted and modified by emollient or mucilaginous excipients. The dose of the officinal aqua ammoniæ (not fortior), or of spiritus ammoniæ, is ♏x to xxx. Several liniments and lotions introduced under the appropriate heads contain one or other of these preparations.

Spiritus Ammoniæ, U. S. P.

The composition of spirit of ammonia is similar to the foregoing, except that alcohol is used as the solvent for the gas; it has nearly

the strength of the officinal solution of ammonia, and is made by passing a stream of the caustic gas into a vessel of alcohol surrounded with ice-cold water. Its only advantage over aqua ammoniæ is for admixture with tinctures, which would be incompatible with an aqueous liquid. It should be kept in small and well-stopped bottles, and like the aqueous solutions of this volatile gas, should be kept in a cool part of the premises, and dispensed with special reference to preventing waste by evaporation.

For internal use the aromatic spirit of ammonia is preferred; they should be carefully distinguished from each other.

Ammonii Carbonas. $(NH_4)_2HCO_3$.

Carbonate of ammonium (sesquicarbonate) is prepared by treating a mixture of chloride or sulphate of ammonium and chalk (soft carbonate of calcium). When chloride of ammonium is used, chloride of calcium and carbonate of ammonium are formed; the latter, being volatile, sublimes, and is collected in a colorless, almost transparent sublimate, with powerful pungent odor and acrid taste. This may be considered as a compound of protocarbonate and bicarbonate of ammonium, one equivalent of each, or as a sesquicarbonate.

No less than twelve different compounds of ammonium carbonic acid and water are described by Rose. The officinal salt is translucent, or white, usually in irregular lumps from the breaking of a large dome-shaped mass at first obtained; it is very hard, and on that account liable to fracture a glass bottle in which it is placed; pungent, soluble in about 4 times its weight of cold water and freely in weak alcohol; its taste is sharp and penetrating; by exposure to the air it undergoes a change into bicarbonate, which is unsuited to many uses.

The stimulant and antacid properties of this salt are very well known; it is given in various modes of combination, some of which will be noticed under the head of Extemporaneous Preparations. Its dose is gr. v.

Hydrated Protocarbonate of Ammonium.(?)—*Smelling salts* are frequently made directly from the powdered sesquicarbonate, or from the mixture of about five parts of granulated chloride of ammonium and seven parts of carbonate of potassium with a little water of ammonia and appropriate flavor. The hydrated protocarbonate of ammonium is, however, preferable for the purpose, and may be conveniently made by mixing 2 parts of commercial (sesqui-) carbonate of ammonium in coarse powder with one part of the strongest water of ammonia, in a well-stoppered bottle, and stirring them together occasionally for a week, then setting the mass aside to solidify, after which it may be powdered, perfumed, and transferred to pungents for sale.

Spiritus Ammoniæ Aromaticus, U. S. P. (*Spirit Sal. Volat.*)

Take of Carbonate of ammonium, a troyounce.
Water of ammonia, three fluidounces.
Oil of lemon, two fluidrachms and a half.
Oil of nutmeg, forty minims.
Oil of lavender, fifteen minims.
Alcohol, a pint and a half.
Water, a sufficient quantity.

Dissolve the carbonate in the water of ammonia, previously mixed with four fluidounces of water. Dissolve the oils in the alcohol, mix the two solutions, and add sufficient water to make the whole measure two pints.

This is a very convenient new formula, superseding the former process, which, requiring the use of a retort and receiver, was seldom practised by the apothecary, but it furnishes a less pleasant preparation than the old process. It will be observed that, besides the neutral carbonate, it contains a small proportion of caustic ammonia. This is necessary to make it correspond in pungency to the old preparation. It is believed that the formula now offered for this valuable remedy will add greatly to its uniformity, while, at the same time, it places it among the preparations readily made in the shop.

Few of our medicines have a wider and more useful sphere than this well-known antacid and stimulant; combined with tinctures and other neutral preparations, it is found to add to their diffusibility, while in doses of from ℥xx to f℥j it meets some very common indications in disease.

Ammonii Bicarbonas. NH_4,HCO_3.

Bicarbonate of Ammonium.—By long exposure to the air, particularly in small fragments, the sesquicarbonate loses its pungency, falls into powder, and by the loss of gaseous ammonia becomes converted chiefly into bicarbonate. By the use of a small quantity of water, protocarbonate may be dissolved out of the commercial carbonate and the less soluble bicarbonate remain. The use of this is as a milder and less stimulating diaphoretic and antacid. Dose, gr. x to ʒj.

In using carbonate of ammonium for its direct stimulating effect, care should be taken that it is free from the pulverulent, white bicarbonate; and where it has deteriorated by the formation of this on the surface of the lumps, they should be scraped away, and cracked, till the vitreous looking hard portion is reached. For saturating acids in the formation of neutral salts, the bicarbonate will answer a good purpose.

Liquor Ammonii Acetatis, U. S. P. (*Solution of Acetate of Ammonia, Spirit of Mindererus.*)

Take of Diluted acetic acid . . . . . Two pints.
Carbonate of ammonium . . . . A sufficient quantity.

Add the carbonate of ammonium gradually to the acid until it is saturated, and filter.

Diluted acetic acid, elsewhere stated, is made by adding one fluidounce of acetic acid to seven fluidounces of water, making eight. It will be found convenient and desirable to consume, in making this preparation, the bicarbonate or the partially bicarbonated sesquicarbonate, which falls readily into powder, and is almost useless for other purposes. By making it in a tincture-bottle in which toward the last the stopper is kept, the solution will be made to absorb a large amount of carbonic acid gas, and to sparkle when decanted. The point of saturation may be determined proximately by the taste, and it is generally not desirable to continue adding the carbonate of ammonium till it is perfectly saturated, as it is far more agreeable to be a little acid than alkaline. This solution should always be made in small quantities, and is generally better to be prepared when required. There is no necessity for filtration if the ingredients are perfectly pure and free from contamination with dust. It is very much prescribed as a mild stimulant and diaphoretic. Dose, f℥j to f℥ss; as an antidote to alcoholic liquids, given while the patient is intoxicated, from f℥ss to f℥j.

Ammonii Citras. (*Citrate of Ammonium.* $3NH_4,\overline{Ci} = 243$.)

This salt is seldom met with in commerce, but in the form of solution made by saturating lemon juice with carbonate of ammonium, it furnishes a stimulating diaphoretic similar to solution of acetate. The dose of the salt is from ℥ss to ℥j.

Ammonii Valerianas, U. S. P. $NH_4,\overline{Va} = 119$.

Take of Valerianic acid, four fluidounces.

From a mixture, placed in a suitable vessel, of chloride of ammonium, in coarse powder, and an equal weight of lime, previously slaked and in powder, obtain gaseous ammonia, and cause it to pass, first through a bottle filled with pieces of lime, and afterwards into the valerianic acid, contained in a tall, narrow glass vessel, until the acid is neutralized. Then discontinue the process, and set the vessel aside, that the valerianate of ammonium may crystallize. Lastly, break the salt into pieces, drain it in a glass funnel, dry it on bibulous paper, and keep it in a well-stopped bottle.

Valerianate of ammonium is a white salt in the form of quadrangular plates, having the disagreeable odor of valerianic acid, and a sharp, sweetish taste. It deliquesces in moist air, but effloresces in a dry atmosphere, and is very soluble in water and in alcohol. It is decomposed by potassa with evolution of ammonia, and by the mineral acids with separation of the valerianic acid, which rises to the surface in the form of an oil.

This is a new officinal preparation in the edition of 1860. The formula is an improvement on that of B. J. Crew, by which the gaseous acid and volatile alkali were brought together, so as to crystallize in a receiver. Few remedies have had so large a share of popularity, for several years past, as this diffusible stimulant and

antispasmodic. It is used in neuralgia, hysteria, and other nervous disorders, in a dilute solution, proposed by Pierlot, and published under another head; and also more recently in the form of *elixir of valerianate of ammonium.*

Ammonii Benzoas. $NH_4\overline{Bz} = 139.$

The neutral salt has been employed in medicine; it is obtained by dissolving benzoic acid in strong ammonia by the aid of heat, not quite to saturation. It is very soluble in water, deliquescent in the air—loses ammonia and becomes solid again. In common with benzoate of sodium, it has been used in gout, also, as an antispasmodic, though in the latter case the activity may be due to the empyreumatic oil which it retains. A correspondent of the *London Lancet* recommends it in anasarca with albuminuria following scarlatina. The dose for a child of six years was 5 grains three times a day.

Ammonii Sulphuretum. (*Hydrosulphate of Ammonium.* $NH_4HS.$)

Water of ammonia saturated with hydrosulphuric acid gas.

It is a yellowish liquid, of a disagreeable fetid smell, which is much used in analytical chemistry for the detection of some of the metals.

It has been recommended as a sedative and in diabetes in the dose of five or six drops largely diluted with water.

It has also been applied to the removal of nitric acid stains, with some caustic potassa, scraping off the colored portion and washing with very dilute HSO_4. Callus and indurated skin may be removed in a similar manner.

Phosphate of Ammonium. $2NH_4PO_4 = 131.$

This has a similar composition to the other medicinal alkaline phosphates. It may be made by saturating a strong solution of phosphoric acid with ammonia, evaporating, and setting the solution aside that crystals may form; or by saturating the excess of acid in superphosphate of calcium with carbonate of ammonium, and procuring the salt by evaporation and crystallization, previously adding ammonium to a slight alkaline reaction. It is a white salt, in efflorescent, rhombic prisms, losing water and ammonia, very soluble in water, but insoluble in alcohol. It was formerly much in vogue as a remedy for gout and rheumatism. Dose, 10 to 40 grains.

Hypophosphite of Ammonium. $NH_4H_2PO_2.$

This is prepared from hypophosphite of calcium and sulphate or carbonate of ammonium.

Take of Hypophosphite of calcium, 6 oz.
Sesquicarbonate of ammonium (translucent), 7.23 oz.
Water, a sufficient quantity.

Dissolve the calcium salt in four pints of water, and the ammonium salt in two pints of water, mix the solutions, drain the resulting carbonate of calcium, and wash out the retained solution with water. The filtrate should then be evaporated carefully to dryness, then dissolved in alcohol, filtered, evaporated, and crystallized.

This salt is deliquescent in the air, very soluble in alcohol and water, and, when carefully heated, evolves ammonia, leaving hydrated hypophosphorous acid. It is used for the same purposes as the other alkaline hypophosphites in a dose of 4 to 5 grains three times a day.

CHAPTER V.

ON THE EARTHS AND THEIR PREPARATIONS.

THE earths are distinguished from the alkalies by the insolubility of their carbonates; and the fact, that the carbonates of some have an alkaline reaction and of others have not, has given rise to the distinction between the class of alkaline earths, to which baryta, lime, and magnesia belong, and earths, including alumina, and several of less importance to the physician and pharmacist.

The order in which they are treated in this work is as follows:—

1st. *Preparations of barium.*
2d. *Preparations of calcium.*
3d. *Preparations of magnesium.*
4th. *Salts containing aluminium.*
5th. *Cerium and its oxalate.*

Baryta. BaO=153.

Like the alkalies and other earths, baryta has a metallic base, which is the white readily oxidizable metal *Barium.*

This alkaline earth is not itself used in medicine, but is the base of several officinal preparations.

Test for Baryta.—The best and most reliable test for baryta is the precipitate which its solutions throw down with free sulphuric acid and all soluble sulphates, even with sulphate of calcium. Sulphate of barium is insoluble in acids and alkalies.

1ST GROUP.—*Of Earths—Preparations of Barium.*

Barii carbonas, Ba,CO_3. Native witherite. Soluble in strong acids.
Barii chloridum, $BaCl_2,2Aq$. Poisonous; used only in solution.
Liquor barii chloridi, ʒj to fʒiij water. DOSE, five drops.
Barii iodidum, BaI. Poisonous; an alterative in scrofula and morbid growths.

Barii Carbonas. $BaCO_3$=197.

Carbonate of barium is a rather rare mineral, being chiefly imported from Sweden, Scotland, and the north of England, in masses of a light grayish color and fibrous texture.

It is soluble in muriatic acid with effervescence, forming salts, which, if soluble, furnish in solution the best tests for sulphuric acid, throwing down a white precipitate insoluble in boiling nitric acid. The solution in muriatic acid is not colored nor precipitated by ammonia, nor hydrosulphuric acid, and when sulphuric acid is added in excess, the solution yields no precipitate with carbonate of sodium.

Barii Chloridum. $BaCl_2$,2Aq.=208.5.

When muriatic acid is added to carbonate of barium, the muriatic acid displaces the carbonic, with effervescence, and with the barium forms chloride of barium and water, $BaCO_3$ and $2HCl = BaCl_2 + H_2O$ and CO_2. By evaporation, the chloride may be obtained in flat, flour-sided crystals, which lose their water of crystallization below 212° F.

It is a white, freely soluble, permanent salt, with a bitter acrid taste, and imparts a yellow color to flame. Its solution is not affected by ammonia or hydrosulphuric acid. When sulphuric acid is added in excess, no further precipitate is produced by the addition of carbonate of sodium. If the crystals deliquesce the presence of another earthy chloride may be inferred. It is poisonous, as are all the other barium salts; it is chiefly used in medicine in the form of

Liquor Barii Chloridi, U. S. P.

Take of Chloride of barium	f℥j.
Distilled water	f℥iij.

Dissolve the chloride in the water, and filter if necessary.

This solution is almost too strong for convenient use; it is stated to be deobstruent and anthelmintic. The dose is about five drops, but it is very rarely prescribed. It is, however, much employed as a test for sulphuric acid or any soluble sulphate.

Barii Iodidum. BaI=264.

Is obtained by dissolving carbonate of barium in hydriodic acid, forming iodide of barium and water with the evolution of carbonic acid, or by adding to an alcoholic solution of iodine finely-powdered sulphuret of barium, and evaporating the filtrate by a moderate heat. Sulphur is precipitated, which is separated by filtration.

It occurs in colorless, deliquescent needles, which are decomposed by the carbonic acid of the atmosphere. It is very poisonous, and has been recommended as a discutient and alterative in scrofulous diseases, internally, in the dose of *one-eighth to a grain* twice daily, and externally in ointments containing 20 to 30 grains to the ounce.

2d Group.—*Of Earths—Preparations of Calcium.*

Marmor (marble). Native hard carbonate of calcium.
Creta (chalk). Native soft carbonate of calcium.
Creta præparata, $CaCO_3$. Levigated and elutriated nodules. Dose, gr. x to ʒj.
Testa (oyster shells). The shell of Ostrea edulis.
Testa præparata. Levigated and elutriated small nodules. Dose, gr. x to ʒj.
Calx, CaO. Lime recently prepared by calcination.
Liquor calcis. Lime-water, contains 9.7 grs. to Oj.
Calcii chloridum, $CaCl_2$. Dissolving carbonate in HCl, and evaporating.
Liquor calcii chloridi. By dissolving one part of $CaCl_2$ in 1.5 of distilled water. Dose, ♏ xxx to fʒj.
Calcii carbonas præcipitata. From $CaCl_2$ by adding Na_2CO_3. Very fine white powder.
Calx chlorinata, $CaCl_2O_2+CaCl_2$. Bleaching salt. Disinfectant.
Calcii phosphas præcipitata, $Ca_3 2PO_4$. Calcined bones precipitated from solution in HCl.
Syr. calc. phosphat. Durand. 2 gr. phosph. calcium to fʒj + 4 gr. phosph. acid.
Syr. calc. phosphat. Wiegand. 5 gr. phosph. calcium to fʒj + muriatic acid.
Calcii hypophosphis, $Ca2PH_2O_2$. By boiling lime and phosphorus.
Syr. calc. hypophos. Procter. 3½ gr. hypophosphite to fʒj.
Syr. hypophosphis comp. Parrish. 5 gr. mixed calcium, sodium, and potassium salts to fʒj.
Liquor calcii bicarbonatis. Solution of carbonate in carbonic-acid water.
Calx saccharatum. A syrup containing caustic lime in union with sugar.
Liquor calcis saccharatus. Ph. Br. 7.11 gr. lime to fʒj solution.
Calcii sulphis. By saturating Ca2HO with HSO_4.
Calcii iodidum. An alterative and poisonous remedy.
Calcii sulphuretum. Used in sulphur baths, etc.

Marmor and *creta* are the names given in the list to two native unorganized forms of carbonate of calcium, while *testa* is applied to the shell of the common oyster. Besides these, there is another form of hard carbonate of calcium, called *limestone*, which, though not officinal, is employed for the preparation of lime.

Creta Præparata and Testa Præparata. $CaCO_3=100$.

Carbonate of calcium for use in medicine requires to be prepared by mechanical processes adapted to furnishing a pure and fine article. Chalk and oyster-shell are subjected to the process of elutriation; being powdered and diffused in water, to allow of the subsidence of crystalline particles, the turbid liquid is drawn off into other vessels, allowed to settle, and dried by being dropped from a suitable orifice on to a drying slab, thus presenting the carbonate in nodules or small pyramidal masses, readily falling into a very fine, impalpable, white powder. In this way prepared chalk and prepared oyster-shell are produced. The precipitated carbonate of calcium is very differently prepared, by means of a chemical process, described, along with the medical properties of the carbonate, on page 205.

Tests for the determination of Lime.—Soluble salts of lime impart to alcohol a yellowish-red color. The neutral salts are precipitated—

By carbonates and phosphates of the alkalies; the white precipitates are soluble in muriatic and nitric acids.

By oxalic acid; the precipitate soluble in muriatic and nitric acids; not in ammonia or excess of oxalic acid.

Sulphuric acid and soluble sulphates throw down a precipitate

of sulphate of calcium from concentrated solutions, soluble in much water and in diluted acids.

Only in very concentrated solutions does a precipitate take place by caustic potassa.

Calx. (*Lime.* CaO=56.)

Lime is the oxide of a light metal called calcium, Ca=40. This oxide exists to a very great extent in the mineral kingdom, being the most familiar of the so-called alkaline earths. It is obtained from the soil by plants, and through them becomes incorporated into the structure of animals, entering specially into their bones, shells, and teeth.

Lime itself is prepared from the carbonate, mostly from limestone, by calcining along with carbonaceous matters. Sometimes with wood, furnishing wood-burnt lime; and at other times with coal, furnishing a more common article. The action of an intense heat drives off the carbonic acid, which escapes, leaving the lime in its caustic state.

On the addition of water, lime becomes slaked, a high heat is produced, and it is found to have absorbed one equivalent of water= Ca2HO=74. Lime is less soluble in hot than in cold water, is fusible before the blowpipe, and entirely soluble in muriatic acid. Silicic acid remains undissolved on the addition of this acid. Phosphate of calcium, if the solution is acid, is thrown down on neutralization with ammonia. Alumina, magnesia, and oxide of iron are thrown down from this solution by a slight excess of ammonia.

Liquor Calcis, U. S. P. *Solution of Lime.* (*Lime-Water.*)

Take of Lime	Four ounces.
Water	One gallon.

Upon the lime first slaked with a little water, pour the remainder of the water, and stir them together, then immediately cover the vessel, and set it aside for three hours. The solution should be kept standing upon the undissolved lime in stopped glass bottles, and poured off clear when required for use.

Lime is soluble to a limited extent, and more so in cold than in hot water. The proportion contained in lime-water is from nine to ten grains to the pint; its dose is from f℥ss to f℥ij. It is particularly useful, in small doses, to allay irritation of stomach and nausea, and, as an astringent antacid, is adapted to dyspepsia accompanied with acidity of stomach and diarrhœa. Its taste and caustic properties are best disguised by admixture with milk; and a mixture of lime-water and milk is much used as food for infants.

Tests.—Lime-water of full strength is rendered turbid on application of heat. If prepared from lime obtained from common limestone, it is apt to contain caustic soda, from the decomposition, by lime, of some silicate of sodium; it is recognized by passing carbonic acid (exhaled air) into it until the lime is precipitated, when the alkaline reaction will not have disappeared.

Calcii Chloridum. $CaCl_2=111$.

The chloride is prepared by dissolving chalk or marble in muriatic acid and evaporating to dryness, after which it may be fused. It is then a white, amorphous mass or powder, with an acrid, bitter, saline taste, very soluble in water and alcohol, and so deliquescent as to be used for drying gases, and for depriving various liquid substances of water. It is also capable of crystallizing, when it absorbs six equivalents of water $=CaCl_2+6H_2O$. If the heat does not exceed 300° in evaporating to dryness, the salt will have the composition $CaCl_2+2H_2O$.

Metallic oxides, if present, may be detected by precipitates in the solution with ammonia and sulphuretted hydrogen. A precipitate by solution of sulphate of calcium would indicate baryta.

Liquor Calcii Chloridi, U. S. P.

Solution of chloride of calcium is directed, in the *Pharmacopœia*, to be made by obtaining the chloride as above, and dissolving it in water in about such proportion that 2.5 parts of the solution shall be equal to one part of the salt.

The officinal process is as follows:—

Take of	Marble, in small pieces	Six troyounces.
	Muriatic acid	Twelve troyounces.
	Distilled water	A sufficient quantity.

Mix the acid with half a pint of distilled water, and gradually add the marble. Towards the close of the effervescence apply a gentle heat, and, when the action has ceased, pour off the clear liquid and evaporate to dryness. Dissolve the residue in one and a half times its weight of distilled water, and filter through paper.

It is rarely prepared or prescribed, although considered a deobstruent and alterative remedy, adapted to scrofulous diseases and goitre. Dose, ℥xxx to f℥j.

Calcii Carbonas Præcipitata, U. S. P. $CaCO_3=100$.

Is prepared by adding carbonate of sodium in solution to the solution of chloride of calcium as above, till effervescence ceases. By double decomposition, carbonate of calcium is formed and precipitated as a white powder, while chloride of sodium remains in solution and is separated by washing. The fineness of this precipitate is dependent upon the degree of concentration and the temperature of the solutions. If dilute and cold, the result would be the formation of a crystalline powder destitute of that softness and miscibility with liquids which adapt it to convenient use. The *Pharmacopœia*, therefore, directs strong solutions and a boiling temperature at the time of mixing them.

When properly made, this is a fine white powder, free from grittiness, insoluble in water, but soluble without residue in diluted muriatic acid, with abundant disengagement of carbonic acid. It is used as an antacid, with astringent properties, adapting it especially to diarrhœa. Dose, from gr. x to ℥j.

As compared with prepared chalk, with which it is identical in composition, this is a far handsomer preparation, and, though less distinctly amorphous, and, therefore, not so thoroughly suspended in liquid forms of preparation, it is preferred for most prescription purposes. It is also well substituted for chalk in dentifrice.

Tests.—Sulphate of calcium, which is an occasional adulteration, may be detected by washing the preparation with distilled water, in which, after filtration, chloride of barium and oxalic acid will produce precipitates.

Phosphate of calcium is left behind on treatment with diluted acetic acid; it is dissolved by muriatic acid, in which solution the phosphoric acid is proved by perchloride of iron and acetate of potassium in excess.

Calx Chlorinata, U. S. P. (*Chlorinated Lime.*)

Under the name of *chloride of lime*, or *bleaching powder*, this substance is extensively manufactured and used as a bleaching agent. It is made from slaked lime by subjecting it to an atmosphere of chlorine gas till completely saturated, and has a complex and variable composition, being a mixture of hypochlorite of calcium, $CaCl_2O_2$, chloride of calcium, $CaCl_2$, and lime, Ca2HO. It is a grayish-white, lumpy powder, having the odor of chlorine, which it gives off on exposure to the air. It is deliquescent, absorbing both moisture and carbonic acid from the air.

For the full advantage of the liberation of chlorine the addition of an acid is necessary, though the spontaneous evolution of that gas is usually relied on for common disinfecting purposes. The chief popular use of chlorinated lime is as a disinfectant about cesspools, sewers, and places rendered offensive and unwholesome by the products of decomposition.

It is also used in the manufacture of chloroform and for the preparation of *liquor sodæ chlorinatæ*, which is used as a substitute for it for internal and external use in medicine.

Tests.—A very moist consistence argues the presence of a considerable proportion of chloride of calcium, and is an indication of inferiority. It is only partially soluble in water, and wholly soluble in muriatic acid; its solution quickly destroys most vegetable colors.

The *Pharmacopœia* gives the following test which shows an amount of chlorine available for disinfecting and medical purposes, of at least twenty-five per cent., and indicates a good commercial quality.

When forty grains, triturated with a fluidounce of distilled water, are well shaken with a solution of seventy-eight grains of crystallized ferrous sulphate, and ten drops of sulphuric acid in two fluidounces of distilled water, a liquid is formed which does not yield a blue precipitate with ferridcyanide of potassium (red prussiate of potash).

This test is based on the oxidation of the iron under the influence of chlorine to sesquioxide; but aside from other objections, the

difficulty of keeping the sulphate of iron entirely unaltered renders this test inaccurate; a better result is obtained by treating thirty-six grains chloride of calcium with fifty-three grains ferrocyanide of potassium, and, after heating to the boiling point, testing with a salt of sesquioxide of iron, which must not furnish a blue precipitate.

By the influence of chlorine, the ferrocyanide is changed into ferridcyanide of potassium; if less than 25 per cent. of chlorine is present, a part of the ferrocyanide remains unaltered, and reacts with the chloride of calcium, the resulting ferrocyanide of potassium and calcium is taken up by boiling water, and throws down a precipitate of Prussian blue with sesquisalts of iron.

Calcii Phosphas Præcipitata, U. S. P. $Ca_3 2PO_4 = 310$.

This salt is made by calcining bones and dissolving them in muriatic acid, from which solution, on the addition of ammonia-water, the phosphate is precipitated.

After washing and drying it is a white insoluble powder, free from odor and taste; soluble in muriatic, acetic, and phosphoric acids.

This phosphate is used as a remedy for scrofulous diseases, defective nutrition, etc. Dose, from gr. x to ʒss, repeated three times a day. It forms the basis of several of the phosphatic preparations now so popular; it is said to be essential in animals, as well as plants, to the formation of cells, and seems to be useful in certain pathological states of the system characterized by defective nutrition.

Tests.—It is insoluble in water, soluble in nitric, sulphuric, hydrochloric, and carbonic acids; its solution in nitric acid is precipitated by oxalate of ammonium; the neutralized nitric solution should give a yellow precipitate of phosphate of silver.

Carbonate of calcium, if present as an adulteration, is detected by its effervescing with acids. Sulphate of calcium is left behind on dissolving the salt in muriatic acid; the residue dissolves in much distilled water, and yields the characteristic precipitate with barium salts.

The granular and rather insoluble character of this powder, as found in commerce, renders it less efficient than desirable, and has led to the preparation of the following syrups, which contain it in a soluble form. See, also, Compound Syrup of Phosphates among the preparations of iron.

Durand's Syrup of Phosphate of Calcium.

Take of Precipitated phosphate of calcium	128 grains.
Glacial phosphoric acid	240 "
Sugar, in coarse powder	7½ oz. (offic.)
Distilled water	4 fluidounces.
Essence of lemon	12 drops.

Mix the phosphate of calcium with the water in a porcelain capsule, over a spirit or gas lamp, or in a sand-bath, add gradually the

phosphoric acid until the whole of the phosphate of calcium is dissolved. To this solution add sufficient water to compensate for the evaporation, then dissolve the sugar by a very gentle heat, and, when perfectly cold, add the essence of lemon. The syrup of phosphate of calcium, thus prepared, is colorless, transparent, of an acid taste, and contains two grains of the phosphate of calcium and nearly four grains of phosphoric acid to each teaspoonful. When diluted by the patient previously to its being taken, it forms a phosphoric lemonade not unpleasant to the taste. Dose, a teaspoonful.

In a paper in the *American Journal of Pharmacy*, vol. xxvi. p. 112, noticing the above, T. S. Wiegand remarks upon the acidity of the preparation as an objection to its use in some cases, and proposes the following modified recipe, containing muriatic acid instead of phosphoric acid, a much smaller proportion being required to constitute a permanent solution.

Wiegand's Syrup of Phosphate of Calcium.

Take of Calcii phosphatis præcip.	℥j.
Acidi chlorohydrici	f℥iv.
Aquæ, q. s. ft.	f℥vij.
Sacchari, q. s. ft.	f℥xij.

Dissolve the phosphate of calcium, previously mixed with an ounce of water, by means of the acid, filter, then add the remaining water to this; add the sugar until the bulk is increased to twelve fluidounces, and strain. Dose, a teaspoonful.

Calcii Hypophosphis. (*Hypophosphite of Calcium.* $Ca2PH_2O_2$=136.)

When phosphorus is boiled with milk of lime, it gradually disappears, with evolution of spontaneously inflammable phosphuretted hydrogen, which explodes as it reaches the atmosphere, with the formation of water and phosphoric acid. When the strong odor of phosphuretted hydrogen ceases to be given off, the liquid contains, besides the excess of lime, nearly half of the phosphorus as phosphate of calcium, and the remainder, deducting the considerable portion which has escaped into the air as phosphuretted hydrogen, is hypophosphite of calcium. When the process is conducted in a flask, it requires a constant ebullition of the liquid to prevent the explosion consequent upon the entrance of the atmospheric air. To avoid this result, it has been found safer to employ a deep, open vessel. The constant evolution of gas and vapor, which keeps a froth on the surface, excludes the atmosphere in a great degree, so that the yield is not much diminished, whilst the safety and ease of the process are greatly increased. The process should be conducted under a hood with a strong draught, or in the open air, to avoid the disagreeable fumes which are evolved.

Take of Lime, recently burned	4 lbs. av.
Phosphorus	1 lb. "
Water	5 galls.

Slake the lime with a gallon of the water, put the remainder in a deep boiler, and as soon as it boils add the slaked lime, and mix to a uniform milk. The phosphorus is now added, and the boiling is kept up constantly, adding hot water from time to time, so as to preserve the measure as nearly as may be, until it is all oxidized and combined, and the strong odor of the gas has disappeared. The mixture froths much, and but little of the phosphorus reaches the surface. Then filter the solution through close muslin, wash out that portion retained by the calcareous residue with water, and evaporate the filtrate till reduced to six pints. The concentrated liquid should now be re-filtered to remove a portion of carbonate of calcium which has resulted from the action of the air on the lime in solution, and again evaporated till a pellicle forms, when it may be crystallized by standing in the drying room, or the heat may be continued with stirring till the salt granulates, when it should be introduced into bottles.

Scheffer prepares it by a modification of this process, which, he says, saves the great waste occurring in the above, and has the advantage of liberating very little of the offensive gas produced by it. He first oxidizes the phosphorus by fusing it under water, and pumping atmospheric air into it; the phosphorus burns somewhat, and swells up, having become partially converted into oxide of phosphorus, P_2O, and now combines with milk of lime without boiling, most readily at 130° F., the gas given off being chiefly hydrogen, and not, as in the other case, the offensive compound of phosphorus and hydrogen, the production of which is so great an annoyance in the neighborhood of chemical manufactories.

Hypophosphite of calcium is a white salt with a pearly margarin-like lustre, and crystallizes in flattened prisms. It is soluble in six parts of cold water, and in not much less of boiling water; slightly soluble in diluted alcohol, but insoluble in alcohol of sp. gr. .835.

This is the most important of the salts of hypophosphorous acid; it is the source from which the acid itself and most of its medicinal salts are made. Immense quantities of it have been prescribed since it was first proposed by Dr. Churchill as a remedy in phthisis, and though the sanguine expectations enkindled by its first announcement have not been realized, it has assumed a prominent place among the remedies adapted to cases of nervous and general debility and ill health. Its dose is five grains three times daily, in sugar and water.

Syrup of Hypophosphite of Calcium. (Procter.)

Take of Hypophosphite of calcium	1 ounce.
Water	9½ fluidounces.
White sugar	12 troyounces.
Fluid extract of vanilla	½ fluidounce.

Dissolve the salt in the water, filter, add the sugar, dissolve by aid of heat, and add the vanilla. The dose is from a teaspoonful (three and a half grains) to a tablespoonful (fourteen grains), according to the circumstances of the case, three times a day.

*Parrish's Syrup of the Hypophosphites.**

The presence of preparations of iron in these compounds was not called for by the original discoverer of their therapeutic value, who considers the alkaline and earthy hypophosphites as superior to any of the ordinary *hæmatogens*, and in practice I believe the following very simple preparations have been found fully equal to those in which iron is introduced with an excess of hypophosphorous acid.

Take of Hypophosphite of calcium	℥iss.
" sodium	℥ss.
" potassium	℥ss.
Sugar	℔j, 12 oz. (com.)
Hot water	Oj f℥iv.
Orange-flower water	f℥j.

Make a solution of the mixed salts in the hot water, filter through paper, dissolve the sugar in the solution by the aid of heat; strain and add the orange-flower water. Dose, a teaspoonful, containing nearly five grains of the mixed salts.

The *glycerole of hypophosphites* has the same composition as the foregoing, except that the solution is formed with a less proportion of water, to which a smaller portion of sugar is added, and the quantity made up with glycerin. We modify the flavor, also, by the use of a little oil of bitter almonds, to distinguish it from the corresponding syrup.

Some pharmacists omit the sugar altogether, and propose this course in making all glyceroles, using glycerin as the solvent, as well as for its nutritive and remedial properties. I do not find this to furnish a pleasant preparation to take, as the saline ingredients have, perhaps, as strong a taste in this form as in an aqueous solution, and in view of the acridity of glycerin as usually met with, I think a teaspoonful a pretty large dose, unless diluted more than is usual with such preparations as glycerole of the hypophosphites which is frequently taken directly from the bottle.

The inferior kinds of glycerin must be avoided in this preparation, as from contact with the salts or other causes they are apt to acquire very offensive properties.

Liquor Calcii Bicarbonatis.

This bicarbonate cannot be obtained in the dry state. It is often contained in spring waters, to which it imparts the property of reacting as acids on litmus and as alkalies on logwood paper. A solution of this salt has been used in England, under the name of *Maugham's Carrara water*, which is made by dissolving Carrara marble, or any other pure carbonate of calcium, in water, saturated with carbonic acid.

It has been used as an antacid absorbent, alterative, and a mild astringent in a number of diseases, particularly in various forms of dyspepsia. The dose of this water is one or two wineglassfuls and more, to the amount of about two quarts per day.

* See Preparations of Iron, Procter's Syrup of Hypophosphites, etc.

Calx Saccharatum. Syrupus Calcis.

Trousseau used the following proportions for producing a solution of lime by the aid of sugar: 1 part of slaked lime, 10 parts water, and 100 parts of syrup are boiled together for a few minutes, strained, and diluted with four times the weight of simple syrup.

This syrup has an alkaline taste and reaction, and is the solution of a chemical compound of sugar and lime. It is used for the same purposes as lime-water, but on account of its causticity it is necessary to dilute it considerably. It is given to children in the quantity of 20 to 30 grains during the day; adults take from 2 to 3 drachms during the same time.

Liquor Calcis Saccharatus, Ph. Br. (*Saccharated Solution of Lime.*)

Take of Slaked lime, one ounce (avoird.).
Refined sugar, in powder, two ounces (avoird.).
Distilled water, one pint (imperial).

Mix the lime and sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water, and, having closed this with a cork, shake it occasionally for a few hours. Finally, separate the clear liquor with a siphon, and keep it in a stoppered bottle. The sp. gr. is 1.052; one fluidounce required for neutralization 254 grain measures of the volumetric solution of oxalic acid, which corresponds to 7.11 grains of lime in one fluidounce.

It should be kept in a well-stopped bottle, and given in the dose of from 20 to 60 minims in a glass of water two or three times a day, after eating. This is stated to be a powerful antacid and tonic, adapted to cases of obstinate dyspepsia connected with too little secretion of gastric juice, as well as to those with too great secretion. It is said to be particularly serviceable to gouty constitutions, though of less use in hysterical and anæmic cases. So far from increasing constipation, it is stated gradually to remove that symptom.

Calcii Sulphis. (*Sulphite of Calcium.* $CaSO_3=122$.)

Neutral sulphite of calcium is prepared by passing gaseous sulphurous acid over hydrate of lime, spread upon hurdles to the depth of one or two inches, or preferably, according to another manufacturing chemist of Prague, by passing the gas into the lime in a barrel, which is made to revolve, by which the contact between it and the lime is increased; the color of the lime is changed from white to a pale yellow in from four to eight hours, and the salt is then removed. It is soluble in about 800 parts of water, and on the addition of most acids, liberates sulphurous acid (HSO_3), which is its principal use. Added to cider in the proportion of a few ounces to a barrel it liberates this acid, and arrests the process of fermentation, a desideratum in this branch of manufacture; the sparing solubility of the salt and of the precipitate formed adapts it to the end in view; no foreign odor or taste is imparted to the cider. This salt, as also the bisulphite and hyposulphite of calcium,

which are more soluble, has been recommended in the purulent stage of consumption as checking the absorption of purulent matter and favoring the cicatrization of vomicæ.

Calcii Iodidum. $CaI_2 = 294$.

The iodide may be prepared by dissolving lime or carbonate of calcium in hydriodic acid, or by digesting a solution of iodide of iron with hydrate of lime, filtering and evaporating the filtrate to crystallization.

It is a deliquescent salt, easily soluble in water, and has a bitter taste. It has been used in scrofulous affections internally, in doses ranging from $\frac{1}{8}$ to 2 grains three times daily, and externally in ointments, containing 2 drachms or less to the ounce.

Calcii Sulphuretum. (*Impure Sulphide of Calcium.*)

If lime diffused in water is decomposed by a current of sulphuretted hydrogen, a solution results, which on evaporation yields a white soft mass, of a sulphurous odor and taste.

It has been used as a depilatory by applying a paste formed with water to the parts, and washing it off after about a quarter of an hour.

The similar compound, prepared by dissolving sublimed sulphur in boiling milk of lime, and diluting the solution, has been employed for the cure of itch, by washing the body with such a solution, or by adding a sufficient quantity to a bath.

The sulphur springs generally contain more or less of this sulphide, which, with hydrosulphuric acid, forms the most active of their constituents.

3d Group.—*Of the Earths, etc.—Preparations of Magnesium.*

Magnesii sulphas, $MgSO_4,7H_2O$. From native carbonate, etc. Dose, ℥j.
Magnesii carbonas, $3MgCO_3,Mg2HO,4H_2O$. From sulphate by Na_2CO_3.
Magnesii carbonas ponderosa. From the same in more concentrated solution.
Magnesii bicarbonas. Fluid magnesia solution with gaseous CO_2.
Magnesia, MgO. By calcining the carbonate. Dose, ℈j.
Liquor magnesii citratis. ℥j of the salt in solution in ℥xij bottles.
Magnesii citras, $3MgC\dot{i}$. By fusing citric acid and adding MgO.
Prepared citrate magnesia. Effervescing powder, mixed citrate bicarb. potass. etc.
Moxon's effervescent magnesia contains $MgSO_4 + 7H_2O$ with $NaCO_3$ and acid. tartar.
Magnesii acetas. In solution with orange syrup.
Magnesii et potass. borotartras. Soluble and mild salt.
Magnesii sulphuretum. Gelatinous alterative. Dose, 5 to 30 grs.

Magnesia, like baryta and lime, has for its base a metal, *magnesium*. This has a brilliant gray color, and sp. gr. of 2.2.

Tests for the detection of Magnesia.—Magnesia is precipitated by the fixed alkalies and their carbonates. The precipitate is soluble in ammonia; so also is the precipitate occasioned by oxalate of ammonium; phosphate of sodium in conjunction with ammonia causes a crystalline white precipitate of $MgNH_4PO_4$, which is insoluble in ammonia and ammoniacal salts, but dissolves easily in acids.

Magnesii Sulphas. (*Epsom Salt.* $MgSO_4,7H_2O = 246$.)

Epsom salt is chiefly prepared from magnesian limestone, called by mineralogists dolomite, and from a native carbonate of magnesium called magnesite brought from the island of Eubœa. By the action of sulphuric acid the magnesia is converted into the soluble sulphate, and the mineral being in excess, the addition of a little freshly precipitated magnesia carries down with it the iron and manganese, so that the sulphate is nearly pure, and by stirring as it passes into a solid consistence is obtained in acicular crystals. At the Jarrow chemical works, South Shields, England, where Epsom salt is produced to the extent of one thousand tons annually, the material employed is the impure sulphate of magnesium, which crystallizes from the residual liquors of the Yorkshire Alum Works. Epsom salt in crystals is soluble in an equal weight of water; it contains over 50 per cent. of water of crystallization, and effloresces slowly by exposure, becoming white and pulverulent. Its sensible properties are familiar to most. In doses of from ℥ss to ℥j, Epsom salt is a brisk saline cathartic; in small doses, a laxative and diuretic. It is much combined with senna, senna and manna, etc., in well-known and very disagreeable infusions.

Tests.—Its solution is not colored nor precipitated by ferrocyanuret of potassium, and gives off no hydrochloric acid on the addition of sulphuric acid. The *Pharmacopœia* also directs the following test of this salt: 100 grains dissolved in water, and mixed with sufficient boiling solution of carbonate of sodium completely to decompose it, yield a precipitate of carbonate of magnesium, weighing, when washed and dried, 34 grains.

Magnesii Carbonas. $3MgCO_3,Mg2HO,4H_2O = 382$.

The carbonate, called also *magnesia alba*, is usually made from sulphate of magnesium, by adding carbonate of sodium, and boiling the mixed solutions. Sulphate of sodium and carbonate of magnesium result from the play of affinities; the former is soluble and is washed out, while the latter is collected, pressed into oblong squares, called bricks, dried at a moderate heat, and wrapped in paper for sale. It is very light, pulverulent, insoluble, tasteless, soft, though somewhat granular and variable in these respects. It is a compound of about one equivalent of bihydrate of magnesia and three of hydrated carbonate of magnesium. It is used as an antacid and laxative, but requires to be given in a larger dose than the calcined; lump magnesia is often carried about by those who use it habitually for heartburn and acidity of stomach.

By boiling it with pure water, this does not acquire an alkaline reaction, nor yield a precipitate with chloride of barium or nitrate of silver. It is wholly dissolved with effervescence by diluted sulphuric acid, and the solution is not precipitated by oxalate of ammonium.

Heavy Carbonate of Magnesium.

This is the result of a similar process to the foregoing, except that the solutions are much more concentrated, or are boiled together until effervescence ceases. It is heavier than the common carbonate, though very similar in composition, and is found in a white rather dense powder, preferred from its small bulk.

Carbonate of magnesium is used chiefly as an antacid, in doses of ℈j to ʒj, though liable to the objection of liberating carbonic acid gas in the stomach, producing eructations and distension.

Bicarbonate of Magnesium

Is a salt quite soluble in water, but which is not permanent, and exists only in solution. The so-called fluid magnesias, of which Murray's, Dinneford's, and Husband's are the best known, are solutions of this salt. They are conveniently prepared by passing a stream of carbonic acid gas into freshly precipitated hydrated carbonate of magnesium, or preferably by forcing the gas into a strong fountain, such as is used for carbonic-acid water, containing the freshly precipitated carbonate. The quantity contained in these solutions is necessarily small, and they have a tendency to deposit the salt as they lose the free carbonic acid; their usefulness is limited to the case of children, and to the treatment of acidity of stomach in adults. The taste is more alkaline and disagreeable than that of the insoluble carbonate, or of magnesia itself.

According to Graham, the crystals deposited from such solutions are compounds of mono-carbonate of magnesium with one, two, or four equivalents of water.

Magnesia. $MgO = 40$.

Usually prepared by calcining the carbonate at a high heat, until it presents a peculiar luminous appearance, called brightening. This preparation is very various in its physical properties, owing to the various modifications of the process for its preparation; it will not be necessary in this work to describe these. The reader is referred, for an account of some interesting experiments made in my laboratory by Thomas H. Barr, of Terre Haute, Ia., and by Thomas Weaver, of Philadelphia, to the *American Journal of Pharmacy*, vol. xxvi. p. 193, and vol. xxviii. p. 214.

Common calcined magnesia is a very light white powder, almost insoluble and tasteless, but imparting a sensation of grittiness to the tongue, which renders it a disagreeable medicine to most persons. It should be entirely soluble in diluted muriatic acid, without effervescence. The presence of lime would be shown by a white precipitate in a neutral solution, with sulphuric or oxalic acid, by which acids magnesia is not precipitated. When moistened it changes turmeric paper brown, but water which has been boiled on it should not be alkaline, nor give a precipitate with chloride of barium or nitrate of silver.

The best varieties in commerce are the English ponderous magnesia, sold in bulk, and Henry's, Husband's, and Ellis's, sold in bottles.

The *ponderous* is not much used in this country; it has the advantage of smallness of bulk, but lacks the extreme softness of the bottled article. *Henry's* leaves nothing to desire; it is very heavy, soft, and smooth, and is highly esteemed among the more wealthy classes; its price, which is enhanced by the payment of duty, almost puts it out of the reach of the middle and poorer classes. *Husband's* is somewhat cheaper and equally good, though, as would be inferred from the ascertained composition, it requires a little larger dose. *Ellis's* is the most recent make; it maintains the same price in bottles as the last named, and approaches it in quality. This is also obtainable by the pound at a somewhat reduced price.

The following abridgment of Barr's table of the composition of these three kinds will show the relative purity of the specimens examined:—

	Henry's. Sp. gr. 3.404.	Husband's. Sp. gr. 3.326.	Ellis's. Sp. gr. 3.386.
Magnesia	94.40	84.306	94.04
Water	.50	11.400	.80
Sulphate of magnesium and sodium, iron, etc.	5.81	3.608	4.41

The dose of magnesia as a cathartic is about ʒj, or, of the common kind, near a tablespoonful; of the heavy kinds, about a teaspoonful; as an antacid, smaller doses are used.

The following excellent process for a dense and soft magnesia is that of the late Thomas Weaver, of Philadelphia:—

Take of	Sulphate of magnesium	℥iv and ʒij.
	Bicarbonate of sodium	℥iij.
	Nitric acid,	
	Carbonate of sodium,	
	Water, of each	Sufficient.

Dissolve the sulphate of magnesium in six ounces of water, add a few drops of nitric acid, and boil for fifteen or twenty minutes; then add sufficient carbonate of sodium, dissolved in a little water, to produce a slight precipitate, and continue boiling for some time, filter, and set aside to cool. Triturate the bicarbonate of sodium with about eight ounces of cold water, and add it to the cold solution of sulphate of magnesium; after frequent agitation filter, transfer to a porcelain capsule and boil quickly till reduced to a small bulk, collect the precipitate, wash thoroughly, and when nearly dry transfer to a crucible free from iron, and calcine at a low heat just approaching to redness. The first part of this process is designed to separate traces of iron as sesquioxide, which it accomplishes most effectually and economically, and the last, to decompose the sulphate at such a temperature as to insure a soft and heavy product. Elevation of the heat above redness seems to produce the grittiness characteristic of common qualities of magnesia.

Liquor Magnesii Citratis.

In presenting a formula for this very popular cathartic beverage, I shall depart from the usual custom of following the *Pharmacopœia*. It is to be regretted that from taking the officinal directions of 1850 many pharmacists have been so unsuccessful as to give up the preparation of the solution, and purchase a less active preparation, so that its manufacture is thrown very much into a few hands. One druggist in Philadelphia has frequently sold a gross of bottles of the citrate per day, on an average, for thirty days in succession.

The recipe below is that which I have used for some years; it is original with myself, and I believe seldom fails to furnish a satisfactory article.

	To make one doz.	To make one bottle.
Take of Citric acid	℥ix (offic.)	ʒvj.
Magnesia	℥ij + ʒv, or sufficient	℥j + gr. xlv.
Syrup of citric acid .	12 fluidounces	f℥j.
Water	1 gallon, or sufficient	f℥xss.

Make an acid solution of citrate of magnesium with the citric acid, magnesia, and 3 pints of the water (f℥iv in making a single bottle); to this add the lemon syrup, and divide the whole among 12 f℥xij bottles (or put into one bottle if the smaller quantity), fill these with the remainder of the water, adjust the corks, and add to each bottle about ϑij of crystallized bicarbonate of potassium.

The quantity of magnesia here indicated is adjusted to an article of average purity; sometimes this weight is found too much and must be diminished to 95 or 100 grains; if, on the other hand, the magnesia is rather poorly calcined, and contains some carbonate, it may be best to increase the proportion from 105 to 110, or even 120 grains to the bottle, though this must be done with great caution, as the slightest excess may occasion the precipitation of a large amount of the hydrated citrate. The strong solution as at first prepared will not keep without precipitation, so that it is necessary to bottle and dilute it without much delay. If the preparation is not decidedly acid, it will be disagreeable to take, and will possess no advantage over the common saline cathartics, but if too strongly acid, it will be almost equally objectionable. The bicarbonate of potassium has the great advantage of neutralizing a portion of the acid, while it forms a very soluble and agreeable salt. If carbonate of magnesium were used to liberate the gas, the tendency to deposit would be increased, which is the greatest practical difficulty with this solution.

The size of the bottle is another point to be observed; it must not fall short of f℥xij. Bottles are made for the purpose both with and without the name of the preparation blown in the glass, which are very appropriate.

The following is the process of the *U. S. Pharmacopœia* for 1870:—

Liquor Magnesii Citratis, U. S. P. (*Solution of Citrate of Magnesium.*)

Take of Carbonate of magnesium	200 grains.
Citric acid	400 grains.
Syrup of citric acid	2 fluidounces.
Bicarbonate of potassium	40 grains.

"Dissolve the citric acid in four fluidounces of water, and, having added the carbonate of magnesium, stir until it is dissolved. Filter the solution into a strong twelve-ounce bottle containing the syrup of citric acid, then add the bicarbonate of potassium and enough water to nearly fill the bottle, which must be closed with a cork and secured with twine. Lastly, shake the mixture occasionally until the bicarbonate is dissolved."

Although the above recipes are perfectly satisfactory for one or two dozen bottles when they are to be sold in a few weeks, it does not answer the purpose of the wholesale manufacturer, or the pharmacist who prepares it for use on shipboard. We are indebted to F. Stearns, of Detroit, for the following practical recipe adapted to these purposes.

Precipitate sulphate of magnesium by adding to it a hot solution of carbonate of sodium (12 lbs. of the carbonate suffice for 10¼ lbs. of the sulphate), wash the precipitated carbonate of magnesium upon a linen filter, drain, and having ascertained the amount of water contained in a sample of known weight by drying and calcining it, introduce the moist hydrate into a suitable apparatus; and to every 1280 grains of anhydrous magnesia the moist hydrate contains, add one gallon of clean soft water (allowing of course for the water already mechanically combined with the hydrate), then subject the whole to the action of carbonic acid gas under a pressure of ten atmospheres for 24 hours, or until the magnesia is dissolved.

Having drawn it off, filter and prepare the solution of the citrate as follows: introduce into f℥xij strong bottles, ten and a half fluidounces of the solution, and one and a half ounce of lemon syrup, not acidulated, and having the corks ready and softened, introduce into each 366 grains of citric acid in crystals, cork and wire immediately. A bottling machine greatly facilitates this operation.

Each bottle of the solution as made by either of these recipes holds a full cathartic dose; divided portions may be taken for its refrigerant and aperient effects, the cork being always carefully secured and the bottle inverted in the intervals of taking the doses.

Soluble Citrate of Magnesium.

Citrate of magnesium is insoluble in water as precipitated from a solution, but is more soluble if made by the direct union of its constituents in a dry condition. The proportion employed must be varied according to the purity of the magnesia and the condition of the acid. Citric acid is what is called a tribasic acid, having three equivalents of basic water (see *Organic Acids*); as found in commerce, it is liable to contain, in addition, either one or two

equivalents of water of crystallization, so that its saturating power is not uniform. The basic citrate ($3MgO,\overline{Ci}$) is the neutral and soluble salt aimed at, and the proportion contained in the following recipe will furnish it in a tolerably eligible form with the use of the commercial acid and magnesia.

Take of	Citric acid (crystallized)	100 grains.
	Calcined magnesia	35 grains.
	Water	15 drops.

Dissolve the acid in the water and its water of crystallization by the aid of heat, then stir in the magnesia; a pasty mass will result, which soon hardens, and may be powdered for use. The chief practical difficulty in the process results from the great comparative bulk of the magnesia, and the very small quantity of the fused mass with which it is to be incorporated. A portion of the magnesia is almost unavoidably left uncombined, and the salt is, consequently, not neutral. This uncombined magnesia should be dusted off the mass before powdering it. Care must be taken to avoid a high temperature, which renders the salt less soluble.

M. E. Robiquet suggests the following formula and manipulation:—

Take of	Citric acid	$35\frac{1}{4}$ parts.
	Carbonate of magnesium	$21\frac{1}{6}$ parts.
	Boiling water	$10\frac{2}{3}$ parts.

Powder the citric acid and dissolve it in the boiling water. When the solution is cold and before it crystallizes, pour it into a wide earthen vessel, and by means of a sieve distribute the carbonate of magnesium evenly and rapidly over its surface without stirring; the reaction takes place slowly; when it ceases, beat the mixture rapidly so long as it retains its pasty consistence.

According to this authority the elevation of temperature occurring during this process is due to a change in the molecular condition by which the salt becomes insoluble; for this reason he recommends that the dish should be placed in a vessel of cold water, and that the salt should be dried at a temperature not exceeding 70° Fahr.

By a modification recently proposed the citric acid and magnesia are triturated together into a powder, and laid away to combine gradually under the influence of atmospheric moisture; I have found this process to yield a slowly soluble salt.

The citrate prepared by these several processes is slowly soluble when first made; it becomes less readily soluble by keeping, and is liable to run into masses which are hard and unmanageable.

The granular powder made in Paris and London, and sold as citrate of magnesia, is composed as follows, according to X. Landerer:—

Take of	Bicarbonate of sodium	360 grains.
	Citric acid	20 grains.
	Tartaric acid	300 grains.
	Sulphate of magnesium	72 grains.
	Oil of lemon	5 grains.

The tartaric acid and bicarbonate of sodium are heated in a porcelain dish just to fusion, allowed to cool, and then mixed with the other ingredients.

It will be seen that this preparation is very incorrectly named, as are most of those sold under similar designations.

The *prepared citrate of magnesium*, of Charles Ellis, Son & Co., is made from the salt as prepared by fusion, combined so as to furnish an effervescing draught, which though not clear contains the undissolved portion so nicely suspended as to be taken without inconvenience. The recipe is as follows:—

Take of	Powdered citrate of magnesium	℥iv.
	Powdered sugar	℥viij.
	Powdered citric acid	℥iiss.
	Powdered bicarbonate of sodium	℥iij.
	Oil of lemon	♏x.

Combine the acid and sugar and rub into a fine powder; dry all the water of crystallization from the acid over a water-bath. Add the citrate of magnesium and oil of lemon, and mix intimately; then add the bicarbonate of sodium and triturate the whole into a fine powder, which must be preserved in a bottle properly excluded from the air. The dose for an adult is from one to three tablespoonfuls mixed in a tumbler of water and drank in a state of effervescence.

Moxon's Effervescent Magnesia.

The following, from Gray's *Supplement*, is for a popular though rather disagreeable aperient:—

Take of	Carbonate of magnesium	℥j.
	Sulphate of magnesium	℥ij.
	Tartrate of potassium and sodium	℥ij.
	Bicarbonate of sodium	℥ij.
	Tartaric acid	℥ij.

To be perfectly freed from the water of crystallization, and mixed and kept in a well-corked bottle.

Dose, from a teaspoonful to a tablespoonful dissolved in water and drank immediately.

Acetate of Magnesium.—This is very deliquescent and difficult to crystallize; in the dry state it is generally found as a gummy mass. It has been proposed as a substitute for citrate of magnesium. Renault recommends to dissolve 120 parts of carbonate of magnesium in acetic acid and evaporate to 300 parts, which solution, when wanted for use, is to be mixed with three times its weight of orange or some other agreeable syrup. It is more agreeable if, like citrate of magnesium, it contains a quantity of free carbonic acid.

Garrot recommended a *syrup of acetate of magnesium*, prepared by dissolving 10 parts calcined magnesia in 50 parts acetic acid, and adding 150 parts of some agreeable fruit syrup. Of similar composition is the *elixir of acetate of magnesium*, prepared by dissolving

10 parts calc. magnesia in 40 parts acetic acid, and adding 40 parts alcohol and 70 of an aromatic syrup.

Magnesii Sulphuretum.—If a boiling solution of sulphate of magnesium is mixed with a concentrated solution of sulphuret of potassium, a white gelatinous mass is precipitated, which, on account of its weaker taste and smell, and milder action, has been recommended for internal use, instead of the true sulphurets of magnesium. Its dose is 5 to 10 grains for children; it operates slightly as a laxative.

Magnesii et Potassii Borotartras.—100 parts of borotartrate of potassium, 24 parts carbonate of magnesium, and 600 parts of water are to be gradually mixed and evaporated. Dissolved with citric acid it has been recommended as a purgative, for which purpose Garrot has proposed the following proportions: borotartrate of magnesium and potassium ʒj, citric acid ʒss, lemon syrup ℥ij, water ℥x.

4TH GROUP.—*Of Earths—Salts containing Aluminium.*

Alumen (ammonia-alum), $2NH_4,SO_4 + Al_3 3SO_4 + 24Aq$. From sulphate of ammonia, etc.

Aluminii et potassii sulphas (potassa-alum), $K_2SO_4 + Al_4 3SO_4 + 24Aq$. Manufactured from alum earths.

Alumen exsiccatum. Deprived of its water of crystallization by heat.

Alumina, $Al_2O_3,3H_2O$. Precipitated by alkalies from alum.

Aluminæ sulphas, $Al_2 3SO_4,9H_2O$. By dissolving alumina in HSO_4, and crystallizing.

Aluminii acetas, $Al_2\bar{A}c + H_2O$.

Aluminium is the name of the metallic radical of the earth *alumina*, a white, faintly bluish metal, which has recently attracted attention from the discovery of an economical process for its extraction; its extraordinary lightness, beauty of color, and indifference to the oxidizing influences of the atmosphere causing it to be recommended as fitted to displace silver, and even platinum, for many purposes in the arts. Experience has not, however, justified its early promise, and it remains among the rare metals.

Alumina, Al_2O_3, is an earth without alkaline properties, existing largely in the mineral kingdom, and the chief constituent of clay. It may be artificially prepared from alum as follows:—

Dissolve alum in six times its weight of boiling water, add solution of carbonate of sodium in slight excess, agitate for a few minutes, filter, and wash the precipitate with distilled water; the product is hydrate of alumina. It may be further purified by dissolving in diluted muriatic acid, precipitating with ammonia, and again washing with water; dried on bibulous paper, it retains three equivalents of combined water, but by a high heat it becomes anhydrous. Pure ammonia-alum, by calcining to a white heat, becomes converted into anhydrous alumina. The hydrated precipitate is freely soluble in diluted acids and in caustic potassa solution.

Alumina is much used as a base for coloring matters, as in the lake pigments. In medicine it is used as an antacid and astringent, with which it combines the properties of an absorbent: it has been

used in purulent and catarrhal affections of the eye. The dose is five to twenty grains three or four times a day.

Tests for Alumina.—Alumina is recognized by being precipitated white by fixed alkalies, redissolved by an excess of the same, and reprecipitated by chloride of ammonium. Compounds of alumina, ignited upon charcoal before the blowpipe, and then moistened with a little protonitrate of cobalt and ignited again, yield an unfused mass of a deep sky blue color.

Alumen. (*Alum.*) *Sulphate of Aluminium and Ammonium.*

$$Al_2 3SO_4, 2NH_4, SO_4 + 24Aq.$$

The alum now most common is ammonia-alum, which is officinal under the name *alumen;* this is made by the use of sulphate of ammonium, as prepared from the residuary liquor of the gas-works, instead of a salt of potassium, as in the old processes, and its composition is as shown in the syllabus.

This complex salt is found in commerce in large crystalline masses, very cheap and abundant, being largely produced for use in the arts. Formerly it was produced from a peculiar ore or schist occurring largely in many parts of the world, and had the composition given above as that of potash-alum.

The properties of the two are so similar that they are seldom distinguished from each other. Where this is desirable, it may be readily accomplished by heat, which dissipates the sulphuric acid and ammonia from ammonia-alum, leaving pure alumina, while in the case of potassa-alum, potassa is a constituent of the residue, and will dissolve on the addition of water, and may be detected by its appropriate tests. Ammonia-alum will also give an odor of ammonia if moistened and triturated with potassa or lime.

Alum is slightly efflorescent in dry air from the loss of a portion of its large amount of water of crystallization; it is soluble in about 15 times its weight of cold water; it is incompatible with alkalies and their carbonates, and, also, with vegetable astringents.

Its uses as an astringent, emetic, and antispasmodic are well known; its dose is from 2 to 10 grains, given to children for whooping-cough; from 20 to 30 grains as an emetic in croup, repeated, if necessary; and from ʒss to ʒj as a purge in lead colic. As a common astringent wash and gargle it is used in solutions of various proportions, from 5 to 30 grains to the ounce.

Alumen Exsiccatum, U. S. P. (*Dried Alum.*)

Take of Alum, in coarse powder, four troyounces.

Expose it in a suitable vessel to a temperature not exceeding 400°, until the residue weighs two troyounces and one hundred and twenty grains; then reduce it when cold to fine powder.

Dried or burnt alum differs from the crystallized salt in containing no water; 474.5 grains of the crystals should yield 258 grains of the anhydrous salt, which is consequently nearly doubled in strength. Care should be taken not to push the heat so far as to

drive off a portion of the sulphuric acid. Dried alum is less soluble in water than alum, but no portion of it should be wholly insoluble.

Dried alum is used exclusively as an external application, as a mild escharotic; it is often reduced in the process of desiccation almost to pure alumina, and in this dry condition is preferred by some physicians, being an excellent absorbent.

Iron alum, *iron and ammonia alum*, *chrome alum*, *and manganese alum* are compounds in which the alumina is substituted by other bases. (*See* Preparations of Iron and Manganese.)

Aluminii Sulphas. (*Sulphate of Aluminium.* $Al_2 3SO_4, 9H_2O = 504.8$.)

This salt is made officinal in the *U. S. Pharmacopœia* for 1860, among the preparations. It is to be made by dissolving equal parts of ammonium alum and carbonate of sodium in separate portions of boiling water, mixing them, and digesting till the evolution of carbonic acid ceases. The alumina thus precipitated is to be collected, washed, and dissolved in sulphuric acid somewhat diluted, and evaporated at a moderate heat to dryness. It is in thin flexible plates of a pearly lustre, sweet and astringent taste, and acid reaction. Soluble in twice its weight of cold water, but not in alcohol.

Its chief use is as an antiseptic in foul ulcers, etc. A solution of one pound in two pints of water is used to preserve dead bodies; as a lotion it may be used in a somewhat less concentrated form.

Under the name of *benzinated solution of alumina*, Mentel proposed the following preparation as a styptic, and, largely diluted with water, as an injection in leucorrhœa and various ulcerated affections: eight ounces of sulphate of aluminium are dissolved in sixteen ounces of water, and saturated with hydrated alumina; six drachms of selected gum benzoin are digested with it for six hours, then cooled and filtered. It has an agreeable odor, and a balsamic, astringent taste. This solution contains $2Al_2 3SO_4$, and is precipitated by a large quantity of water, Al_2SO_4 being separated while the neutral salt remains in solution.

Aluminii Acetas. (*Acetate of Aluminium.* $Al_2 3\overline{Ac}$.)

A solution of this salt is obtained by saturating acetic acid with hydrated alumina, and cannot be evaporated without the loss of acetic acid. It has a faint smell of acetic acid and a sweetish taste, and possesses antiseptic properties.

It has been used medicinally on account of its astringent properties, in diarrhœa and gleet in doses of a half to one drachm within twenty-four hours, and as an injection in various affections requiring astringent applications.

5TH GROUP.—*Cerium and its Oxalate.*

Cerium. Ce = 91.3.

This metal is associated with *lanthanum* and *didymium* in *cerite*, *allanite*, and a few other rare minerals. The most abundant of these is cerite, which is found in Sweden; it contains the oxides of the three metals, together with silicic acid, lime, copper, bismuth, molybdenum, and oxide of iron. The metal is a gray powder, which acquires the metallic lustre by pressure, decomposes water slowly at ordinary temperatures, quickly at the boiling heat. It forms two oxides, protoxide CeO, and sesquioxide Ce_2O_3, the former of which enters into its medicinal salt.

Cerii Oxalas. $2CeC_2O_4 + 3H_2O$.

To prepare this salt the mineral cerite is to be powdered and formed into a paste with sulphuric acid in a porcelain dish, the dish is then to be heated until the mass ceases to swell up, and no longer absorbs additional HSO_4, which must be added cautiously. This mass, being now dried and powdered, is placed in a Hessian crucible, in which it is exposed to the heat of an anthracite fire until it has assumed a pale brownish-red color. It is now to be lixivated with hot water and subsequently with diluted nitric acid, and the solution treated with sulphuretted hydrogen to precipitate the heavy metals. Some hydrochloric acid is now added to hold in solution the oxalate of lime to be formed and then oxalic acid is added to throw down the oxalates of cerium, lanthanum, and didymium. This precipitate is to be washed with warm water, then transferred to a mortar and formed into a paste with one-half the weight of the mineral in carbonate of magnesia, which paste is to be dried on a porous fire-brick, then rubbed fine and calcined in an open stove until the powder has assumed the color of cinnamon. In this condition it contains the cerium in the form of peroxide, which readily dissolves in concentrated nitric acid to be carefully added in a beaker, and heated by a water-bath. After freeing the solution of some of the excess of HNO_3 by evaporation and diluting it with water, it is to be added to boiling water containing a little more than $\frac{1}{2}$ per cent. of oil of vitriol. There should be about a quart of water to every ounce of the mineral worked. A yellow precipitate of basic sulphate of sesquioxide of cerium is formed, while a little of the neutral sulphate of the same oxide and all the lanthanium and didymium remain in solution. The yellow basic sulphate is now washed, dissolved in sulphuric acid, and then reduced to a protosulphate by the addition of a few crystals of hyposulphite of sodium. The liquid is now finally precipitated by oxalic acid, and yields oxalate of protoxide of cerium. This is the process of Prof. F. F. Mayer, of New York. (See *American Journal of Pharmacy*, 1860.)

In the *Medicial Times and Gazette*, Sept. 17, 1859, Prof. Simpson, of Edinburgh, published a description of the use of this salt as a

remedy for obstinate vomiting in pregnancy, since which time it has been extensively prescribed in Europe and in the United States as a sedative tonic to the stomach, resembling in some degree the salts of bismuth, though with peculiar and, perhaps, specific application to the cure of obstinate vomiting, and although, of course, in many cases it has disappointed the expectations of practitioners, it has, I think, justified the claim made for it, that it will arrest obstinate vomiting in a greater number of cases than any other single remedy. The dose is from one to two grains three times a day in pills.

Oxalate of cerium is a white powder, insoluble in water but soluble in HSO_4, by which it is distinguished from the other insoluble oxalates of the earths. Its solution yields a precipitate with caustic alkalies, even in presence of chloride of ammonium, which is not soluble in an excess of the precipitant. A shade of pink or rose color indicates the presence of didymium, and perhaps few commercial specimens of the oxalate of cerium are entirely without this impurity.

CHAPTER VI.

IRON AND MANGANESE.

Ferrum. (Iron. Fe = 56.)

This indispensable metal is too well known to require a description of its sensible properties. It has a specific gravity of 7.7; though not acted on by the dry atmosphere or by pure water, it is rapidly oxidized by water containing carbonic acid, hence the production of protocarbonate of iron with evolution of hydrogen; the subsequent conversion of this into hydrated sesquioxide constitutes the ordinary phenomenon of rusting. Its purest common form is that of wire, or preferably card teeth. The filings (Ferri Ramenta), when obtained as a residuum from the manufactories, are apt to be contaminated with other metals. They are also liable to rust, which is objectionable in some instances.

The salts of iron used in medicine are numerous, including salts of the protoxide, of the sesquioxide, and of the black or magnetic oxide, and also halogen salts. The salts of protoxide, FeO, are now generally termed by chemists ferrous salts, and are accordingly named ferrous sulphate, ferrous carbonate, etc., while the salts of the peroxide (sesquioxide), Fe_2O_3, are named ferric salts, as ferric sulphate, ferric oxalate, etc., and the salts of the black oxide, which may be regarded as a compound of the proto- and sesquioxide (FeO,Fe_2O_3), are named ferroso-ferric salts, and the chlorides, iodides, etc., follow the same rule. This rule, which gives simplicity and accuracy to the nomenclature of this and of the other metals, is not

yet adopted in the *Pharmacopœia*, and the terms are only employed in this work as synonyms.

The officinal names of the halogen and analogous compounds are likewise different in some instances from those adopted by modern chemists, for while the compounds of chlorine are called chlorides, those of sulphur have the termination *uret;* the cyanogen compounds, formerly terminated in the same way, are in the recent edition called cyanides and ferrocyanides.

Iron is conveniently recognized in its *protosalts* (ferrous salts) by the following tests. They have a pale-green color in solution, potassa and soda throw down a white hydrate, which changes by exposure to the air to gray, green, bluish-black, and then to the red sesquioxide. Alkaline carbonates affect them similarly. They are not precipitated by sulphuretted hydrogen, as many metallic salts are, but give a black precipitate with alkaline sulphurets. They give a nearly white precipitate when free from sesquisalts, with ferrocyanide of potassium; by exposure this becomes blue; by ferridcyanide an intense blue is immediately produced. Tannic acid only blackens these salts when they contain sesquisalts.

The *sesquisalts* of iron (ferric salts) have generally a yellowish-brown tint, but by dissolving an excess of ferric oxide become brownish-red. Alkalies and alkaline carbonates throw down a red-brown precipitate of hydrated sesquioxide; sulphuretted hydrogen converts them into protosalts with precipitation of sulphur; ferrocyanide of potassium throws down Prussian blue, but the ferridcyanide has no effect, except upon protosalts. Tannic acid produces a bluish-black precipitate, the basis of common black ink; in the presence of some vegetable acids no precipitate occurs with alkalies, and no blackening with tannic acid if the acid is in excess.

Perhaps no class of remedies, certainly none derived from the mineral kingdom, are so universally esteemed for tonic and astringent properties as the salts of iron, and accordingly pharmacists have expended much ingenuity and skill in improving their quality and extending their number, till they have become leading articles of materia medica, while some of them, by being formed into solutions, tinctures, wines, syrups, and elixirs, are rendered unusually eligible for common use.

In presenting the numerous preparations of iron used in medicine in the form of syllabi and in detail, various methods of classifying them have suggested themselves, but none which seemed to offer sufficient advantages to compensate for the increased complexity necessarily given to the subject by the attempt. The natural division into oxy-salts and the halogen compounds seemed the only one which could be profitably introduced, and I have accordingly grouped the fifty-six preparations which follow under these two heads, consulting convenience and their natural relations to each other in the subordinate arrangement.

Syllabus of Preparations of Iron.

(See Second Group—Halogen Compounds.)

1st Group.—*Oxysalts and Preparations from them.*

Name.	Composition, etc.	Dose.	Description, etc.
Ferri Sulphas	$FeSO_4+7Aq$	gr. v	Green crystals.
Ferri Sulphas Exsiccata	$FeSO_4,Aq$	gr. iij	Whitish powder.
Ferri Subcarbonas	$FeCO_3+Fe_2O_3,2Aq$	gr. x to ℈j	Reddish-brown powder.
Pilulæ Ferri Carbonatis	$FeCO_3$+Mel and sacchar.	gr. x to ℈j	Dark pilular mass.
Ferri Carb. Effervescentes	$FeCO_3$ in ʒiss	ʒiss	Granulated powder.
Ferrum Redactum	Fe	gr. j to gr.ij	Gray impalpable powder.
Liquor Ferri Tersulphatis	$Fe_2 3SO_4$ in Aq	.....	Red-brown, sp. gr. 1.32.
Liquor Ferri Subsulphatis	Excess of Fe_2O_3	.....	Ruby-red, sp. gr. 1.552.
Ferri Oxidum Hydratum	$Fe_2 6HO$	fʒj to fʒss	Reddish-brown magma.
Ferri et Quiniæ Sulphas	.....	gr. j to iv	Colorless octohedrons.
Ferri et Ammonii Sulphas	$Fe_4 3SO_4(NH_4)_2$ SO_4+24H_2O	gr. iij to vj	Violet tinted crystals.
Liquor Ferri Citratis	ʒj $Fe_2O_3\overline{Ci}$ in fʒij	.....	Red syrupy liquid.
Ferri Citras	$Fe_2O_3\overline{Ci}$	gr. iij to v	Garnet-red scales.
Ferri et Ammonii Citras	$Fe_2O_3,NH_4O,\overline{Ci}$	gr. iij to v	" "
Ferri et Quiniæ Citras	gr. j in 6 grs.	gr. iij to v	Greenish-brown scales.
Ferri et Strychniæ Citras	gr. j about in 100 grs.	gr. j to iij	Garnet-red scales.
Ferri et Zinci Citras	.....	gr. j to iij	Brownish-green scales.
Ferri et Magnesii Citras	.....	gr. iij to xij	Greenish-yellow scales.
Syrupus Ferri Citratis	ʒj to fʒj	♏ xx to fʒj	Citrate of magnetic oxide.
Syr. Ferri Protocitratis	ʒj to fʒj	♏ xx to fʒj	Citrate of protoxide.
Ferri Phosphas	Variable	gr. v to x	Slate-colored powder.
Syr. Ferri Superphosphatis	gr. v to fʒj syrup	fʒj	With excess of PO_5.
Syr. Ferri et Ammon. Phosph.	gr. ivss to fʒj+ gr. iijss H_3PO_4	fʒj	(Jos. Roberts'.)
Syr. Ferri et Calcii. Phosph	Complex	fʒj	Red. "Chemical food."
Ferri Pyrophosphas	$2Fe_2O_3H_3PO_4+$ $2NH_4\overline{Ci}+H_2O$	gr. v	Apple-green scales, soluble.
Syr. Ferri Pyrophosphatis	gr. ij to fʒj	fʒj	No ferruginous taste.
Ferri Hypophosphis (*Proto*).	$Fe2HPO_2$	.....	Not found in commerce.
" " (*Sesqui*).	$Fe_2O_3 3HPO_2$	.....	Not found in commerce.
Syr. Ferri Hypophosphitis	gr. j to ʒj syrup	fʒj	Used in phthisis.
" " " *Comp.*	Complex	fʒj	(Thompson.)
" " " "	"	fʒj	(Procter.)
Ferri Lactas	$Fe\overline{L}$?	gr. ij to v	Greenish-white grains.
Ferri Acetas	$Fe_2\overline{Ac}$?	.....	Only in solution.
Liquor Ferri Acetici	11.43 per cent. $Fe_2\overline{Ac}$	.....	Sp. gr. 1.143.
Tr. Ferri Acetat. Ætherеus	contains acetic ether	fʒss	Agreeable.
Tinct. Ferri Acetici	.....	fʒss to fʒj	(Rademacher.)
Ferri Tannas	$Fe_2\overline{Tan}$	gr. x	Black, insoluble.
Ferri Valerianas	$Fe_2 3\overline{Va}$	gr. j to ij	Dark-red, amorphous.
Ferri et Potassii Tartras	KFeT+Aq	gr. x to xx	Reddish-brown scales.
Ferri et Ammonii Tartras	NH_4Fe_2T+Aq	"	" "
Ferri Prototartras	FeT ?	"	Crystals or powder.
Liq. Ferri Nitratis	$Fe_2 6NO_3$+Aq	♏ v to xv	Sp. gr. 1.06, pale amber.
Syr. Ferri Protonitratis	$FeNO_3$ in Syr.	♏ v to xv	
Liq. Ferri Hyperchloratis	Fe_2HClO_4 in Aq	♏ v to x	

Ferri Sulphas. (*Ferrous Sulphate, Copperas, Green Vitriol.* $FeSO_4 + 7Aq = 278$.)

Prepared by dissolving iron wire in diluted sulphuric acid. One eq. of iron, decomposing one of water, combines with its oxygen, and forms protoxide, which last unites with one eq. of sulphuric acid to form sulphate of protoxide of iron, $Fe + H_2O + SO_3 = FeSO_4 + H_2$. The hydrogen is liberated in a gaseous form, and may be collected for experiment. Green vitriol, or copperas of commerce, which is used in the arts, is an impure sulphate, containing peroxide; it is prepared from the native sulphuret, and may be purified by digestion with iron and recrystallization.

When pure, sulphate of iron is in light bluish-green rhomboidal prisms, having an astringent, styptic taste. It dissolves in about one and a half times its weight of cold water; is insoluble in alcohol; when exposed to air and moisture it oxidizes, and becomes covered with a brownish-yellow persalt. It effloresces in dry air, becoming white on the surface.

The presence of copper may be detected by placing a clean polished spatula in the solution; if copper is present, it will be precipitated with its characteristic color on the surface of the iron.

Ferri Sulphas Exsiccata.—Owing to the large amount of water in these crystals, the salt is inconvenient to dispense, in combination with vegetable substances, in the form of powder or pill; and hence, in the *U. S. Pharmacopœia*, is directed to be exposed to a heat increased to 300°, till it ceases to lose weight, and is converted into a dry whitish mass, which is to be reduced to powder. By this it loses six equivalents of water, and is consequently much stronger than the crystallized salt ($FeSO_4 + 7Aq = 278 - 108 = 170$).

In addition to the "hæmatic" virtues common to the iron salts, sulphate is decidedly astringent. It is prescribed internally in cases attended with immoderate discharges, and is also used in injections, though less frequently than sulphates of zinc and copper. Dose, in crystals, five grains; dried, three grains.

This is one of the cheapest and best of disinfectants, especially when mixed with lime, which, by neutralizing a portion of the sulphuric acid, liberates the oxide of iron, and this, by its affinity for additional oxygen, destroys effete matter.

Ferri Sulphas Granulata, Ph. Br. (*Granulated Sulphate of Iron.*)

Take of	Iron wire	4 ounces (avoirdupois).
	Sulphuric acid	4 fluidounces (imp. meas.).
	Distilled water	1 pint and a half (imp. meas.).
	Rectified spirit	8 fluidounces (imp. meas.).

Pour the water on the iron placed in a porcelain capsule, add the sulphuric acid, and, when the disengagement of gas has nearly ceased, boil for ten minutes, and then filter the solution into a jar containing the spirit, stirring the mixture so that the salt shall separate into minute granular crystals. Let these, deprived by decantation of adhering liquid, be transferred on filtering paper to porous tiles, and dried by exposure to the atmosphere. They should

be kept in closed bottles. Its chemical composition is the same as the last described salt.

Ferri Subcarbonas. (*Precipitated Carbonate of Iron.*)

Made by decomposing sulphate of iron by means of an alkaline carbonate, as the carbonate of sodium. The sulphuric acid unites with the soda to form sulphate of sodium, which remains in solution, while the carbonic acid unites with protoxide of iron to form protocarbonate of iron, which precipitates. When first formed, it is a bulky greenish, almost white, precipitate, which may be converted, by admixture with honey and sugar, into Vallette's mass; but when dried in air, it becomes much darker, and finally brown, from more or less conversion into the sesquioxide and loss of carbonic acid. If the drying is carried on at a temperature not exceeding 80° F., this change is only partial, and the preparation effervesces when thrown into acids, and has a brown color. This is a much more soluble form, and to be preferred to the bright red-colored powder obtained by heating.

It should be wholly dissolved by dilute muriatic acid with slight effervescence, forming a solution from which the oxides of iron are completely precipitated by an excess of ammonia; the liquid remaining should not be colored by hydrosulphuric acid or ferrocyanide of potassium.

The subcarbonate of iron is one of the most popular of the chalybeate salts. It has, to a less extent, the medical properties attributed to iron reduced by hydrogen, with a more agreeable effect from swallowing it. The carbonate is not astringent, and produces little or no action upon the mucous membranes of the alimentary canal. Dose, gr. v. to ℈j.

Pilulæ Ferri Carbonatis, U. S. P. (*Vallette's Mass.*)

Take of	Sulphate of iron	Eight troyounces.
	Carbonate of sodium	Nine troyounces.
	Clarified honey	Three troyounces
	Sugar, in coarse powder	Two troyounces.
	Boiling water	Two pints.
	Syrup	A sufficient quantity.

Dissolve the salts separately, each in a pint of the water, a fluidounce of syrup having been previously added to each pint. Mix the two solutions, when cold, in a bottle just large enough to hold them, close it accurately with a stopper, and set it by that the carbonate of iron may subside. Pour off the supernatant liquid, and, having mixed water, recently boiled, with syrup in the proportion of a pint to the fluidounce, wash the precipitate with the mixture until the washings no longer have a saline taste. Place the precipitate on a flannel cloth to drain, and having expressed as much of the water as possible, mix it immediately with the clarified honey and sugar. Lastly, by means of a water-bath, evaporate the mixture, constantly stirring, until it is brought to the weight of eight troyounces.

This valuable preparation is made by nearly the same process as

the foregoing, except that the bulky greenish precipitate thrown down by the carbonated alkali, instead of being dried in contact with the air, is mixed with a suitable proportion of saccharine ingredients, to protect it from contact with atmospheric oxygen and to embody it in a pilular mass; it is well adapted to use as a vehicle for tonics, especially dry powders, in the form of pill. Much that is met with in commerce is too soft even for this use; when desired of firmer consistence it will be found advantageous to use three troyounces of sugar and two of honey; made strictly by the officinal directions it will be found a convenient pilular mass, though becoming softer by exposure.

The dose is ten grains to a scruple.

Syrupus Ferri Protocarbonatis.

The formula given under this head in the late edition of this work was extracted from the journals without having been sufficiently tried. Subsequent experience has proved that it is too imperfect to justify its republication, and the efforts made to improve it have not as yet been successful in producing a permanent syrup, containing a sufficient proportion of the ferruginous salt to be available. A good formula for a liquid preparation of the protocarbonate of iron is still one of the pharmaceutical desiderata.

*Effervescing Carbonate of Iron.**

Take of Tartaric acid	3	troyounces.
Bicarbonate of sodium	5	"
Sulphate of iron	10	drachms.
Powdered white sugar	14	"
Citric acid	2	"

Mix the sulphate of iron with the sugar and part of the tartaric acid. Mix the citric acid with the remainder of the tartaric acid and bicarbonate. Stir the two mixtures together and thoroughly unite them by sifting; then put the whole into an open metallic vessel, in a water-bath, and stir until it is well granulated. These proportions are designed to furnish four grains of protocarbonate of iron in every drachm and a half (teaspoonful) of the powder, which must be kept dry in a well-stopped bottle, and will furnish an elegant chalybeate preparation, adapted to being dissolved in a glass of water and taken during the effervescence produced.

Ferrum Redactum. Fe = 56. (*Ferri Pulvis*, U. S. P. 1850. *Iron by Hydrogen—Quevenne's Iron.*)

Prepared by passing a stream of hydrogen over the washed and calcined subcarbonate (dry sesquioxide) contained in a wrought iron reduction tube of four inches in diameter heated to low redness, continuing the flow of hydrogen till vapor of water is no longer

* The above formula is that of Dr. T. Skinner, as published in the London *Chemist and Druggist*, Nov. 1861. See also formula of Prof. J. M. Maisch, *Proc. of Am. Ph. Assoc.* 1856, p. 55.

given off and till the reduction tube has cooled; the oxygen of the oxide combines with hydrogen, forming water, and leaves the metal in soft masses of impalpable iron, which, on trituration, yield the *Quevenne's iron* of commerce.

It is an impalpable powder, of a steel-gray color, soluble in sulphuric acid diluted with 60 parts of water, with rapid evolution of hydrogen which should not be contaminated with sulphur. It oxidizes when exposed to damp air, and should be kept in closely-stopped bottles. It is usually contaminated with a little carburet, black oxide, and occasionally sulphuret of iron. These impurities give it a dull black color. When well prepared, it will burn on the application of a lighted taper; and a small portion of it, struck on an anvil with a hammer, forms a scale having a brilliant metallic lustre.

Reduced iron possesses in a high degree the property of restoring to the blood this essential ingredient, when it is deficient. From its extreme fineness, it is readily soluble in the stomach, and the chief objection to its use is that occasionally it produces eructations of hydrogen; or, if it contains sulphuret or carburet of iron, sulphuretted or carburetted hydrogen is evolved.

This, like other iron preparations, is apt to produce astringent effects, though less so than the persalts; hence the occasional use of mild purgatives during its administration. It also blackens the stools. It is usually given in the dose of one or two grains three times a day. Given in lozenges, made with chocolate, its taste is pretty well disguised. In pills it is either combined with the tonic extracts or given alone.

Liquor Ferri Tersulphatis, U. S. P. (*Solution of Tersulphate of Iron.*)

Take of Sulphate of iron, in coarse powder, twelve troyounces.
Sulphuric acid, two troyounces and sixty grains.
Nitric acid, a troyounce and three hundred and sixty grains.
Water, a sufficient quantity.

Mix the acids with half a pint of water in a capacious porcelain capsule, and, having heated the mixture to the boiling point, add the sulphate of iron, one-fourth at a time, stirring after each addition until effervescence ceases. Then continue the heat until the solution acquires a reddish-brown color, and is free from nitrous odor. Lastly, when the liquid is nearly cold, add sufficient water to make it measure a pint and a half.

This process consists in the conversion of the sulphate of protoxide of iron, $Fe,SO_4 + 7Aq$, into the tersulphate of sesquioxide, $Fe_2 3SO_4$, which is in solution in the preparation when finished. The addition of nitric acid to a salt of an oxide having so great a tendency to pass into a higher state of oxidation effectually changes its composition, and the additional sulphuric acid added is for the complete saturation of the resulting sesquioxide.

In Monsel's solution which follows, the proportions are varied so as to secure an excess of sesquioxide, and a less caustic and acid solution.

This preparation is made officinal chiefly for the extemporaneous preparation of the hydrated sesquioxide of iron, and for use in effecting the formation of other sesqui-salts of iron by double decomposition.

It is a light reddish-brown liquid, nearly devoid of odor, and of an acid and extremely styptic taste. Its specific gravity is 1.320. It mixes with water and with alcohol in all proportions without decomposition. A fluidounce of it should yield, on the addition of ammonia in excess, a bulky reddish-brown precipitate, which is free from black discoloration, and which, when washed, dried, and ignited, weighs sixty-nine grains.

Liquor Ferri Subsulphatis, U. S. P. (*Monsel's Solution.*)

Take of Sulphate of iron, in coarse powder, twelve troyounces.
Sulphuric acid, a troyounce and thirty grains.
Nitric acid, a troyounce and three hundred grains.
Distilled water, a sufficient quantity.

Mix the acids with half a pint of distilled water in a capacious porcelain capsule, and, having heated the mixture to the boiling point, add the sulphate of iron, one-fourth at a time, stirring after each addition until effervescence ceases. Then keep the solution in brisk ebullition until nitrous vapors are no longer perceptible, and the color assumes a deep ruby-red tint. Lastly, when the liquid is nearly cold, add sufficient distilled water to make it measure twelve fluidounces.

After all that has been heretofore published on the preparation of Monsel's solution, this new recipe of the *Pharmacopœia* of 1860 commends itself to favor as simple, and readily practicable. It is a stronger solution than the solution of tersulphate of iron, and differs from it in containing an excess of the sesquioxide, so that it is less irritating and produces its styptic and hæmostatic effect without causing sloughing; dentists use it as an application to spongy gums and bleeding surfaces, and to produce that contraction of tissues which it is often so desirable to hasten. Perhaps no application is so efficient to arrest hemorrhage, or so useful in treating bleeding from bone, from erectile tissues, or from hæmorrhoids; it is also used with success in the treatment of varices.

Monsel's solution is an inodorous, syrupy liquid, of a ruby-red color, and of an extremely astringent taste, without causticity. Its specific gravity is 1.552. It mixes with water and with alcohol in all proportions without decomposition, and yields, with ammonia, a bulky reddish-brown precipitate. It is used internally in a dose of 5 to 10 drops for hemorrhages, and where an astringent is indicated.

Persulphate of Iron. $2Fe_2,5SO_4(?)$

The salt is so very deliquescent as to be considered ineligible for use in any other form than that of solution, and when dried on plates of glass, as the citrate of iron is obtained, it is often difficult to remove on account of its adhesion. It is recommended to dry it

by artificial heat in a stove, or, by Dr. Lawrence Smith (see *Am. Journ. Pharmacy*, 1863, page 203), to concentrate the solution to the sp. gr. 1.60, and form it into shallow plates from one-quarter to one-sixteenth of an inch in depth, mixed with a little of the dry salt previously desiccated and powdered, and place it near escaping steam (as from a steam jacket) at a temperature of 75° to 100° F. Under these circumstances he finds the salt to become dry and pulverulent with very little disposition to deliquesce. If produced in this way it would, undoubtedly, be much used as a direct application in the form of powder. It has a yellow color, and forms a clear solution, on standing, with water.

Ferri Oxidum Hydratum. ($Fe_2 6HO = 98$.) (*Hydrated Oxide of Iron. Ferri Sesquioxidum Hydratum. Hydrated Ferric Oxide.*)

This is made by adding ammonia in excess to the solution of tersulphate as above. The alkali neutralizes the sulphuric acid, and throws down the oxide of iron as a reddish-brown precipitate. This, if designed for use as an antidote for arsenic, is to be collected on a strainer, water being passed through it to dissolve out the sulphate of ammonia, and then squeezed out, and the moist brown magma transferred to a wide-mouth bottle and kept under a stratum of water. In cases where poisoning has taken place, it is advisable not to wait until all the sulphate of ammonium has been washed out, as the slightly stimulating effect produced by the ammonia is in nowise hurtful. It has been ascertained, however, that by long standing, under these circumstances, the hydrated oxide loses wholly or in part its power of neutralizing arsenious acid, hence the necessity of keeping the solution of persulphate and reserving the addition of ammonia till the emergency requiring its use shall occur. As will appear in several of the recipes which follow, the hydrated sesquioxide comes in play in making some of the persalts of iron; it is also an eligible medicine for producing the usual tonic effect of the iron preparations, and may be dried at a temperature not exceeding 180° F., without losing its constitutional water; at a red heat it becomes anhydrous.

Its dose in the form of magma is f℥j; as an antidote f℥ss every five or ten minutes till a large excess has been given. Should the poisoning have occurred from the use of liq. potassii arsenitis, it will be proper to add a small quantity of dilute acetic acid to the first two or three doses of the antidote.

Ferri et Quiniæ Sulphas.

Take of	Sulphate of iron	125 grains.
	Sulphuric acid	14 minims.
	Nitric acid	25 minims, or sufficient.
	Water	A sufficient quantity.

Dissolve the sulphate of iron with the sulphuric acid in the water and boil it, adding the nitric acid gradually, till it ceases to produce a dark color; when cold, add—

	Sulphate of quinia	A troyounce,

in water, with sufficient sulphuric acid to form a solution; set this aside that crystals may form, which may require several months. It is in colorless octohedrons of a strongly bitter taste, and nearly insoluble in water.

The salt combines the virtues of iron and quinia, and may be prescribed in doses of from one to five grains. It is stated to be more astringent than the citrates of these bases, and perhaps does not possess advantages to compensate for its great cost.

Ferri et Ammonii Sulphas. $Fe_4,3SO_4 + (NH_4)SO_4 + 24$ Aq.
(*Ammonio-ferric Alum.*)

Take of Solution of tersulphate of iron . 2 pints.
Sulphate of ammonium . . . . 4 troyounces and a half.

Heat the solution of tersulphate of iron to the boiling point, add the sulphate of ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air. (*U. S. P.*)

This salt is in elegant violet-tinted crystals of a more or less octohedral form; soluble in one and a half parts of water at 60°, and in less than its weight of boiling water; potassa added to the solution gives a reddish-brown precipitate; when rubbed with potassa and moistened, the salt emits the odor of ammonia. Its peculiar merit consists in its marked astringency without the stimulating properties of some of this class of salts. It is easily assimilated when taken internally. Dose, 3 to 6 grains; while it controls excessive discharges, it is often useful in correcting their cause. It is, perhaps, more employed as an injection in leucorrhœa than for any other use; the proportions prescribed for this purpose may vary from half an ounce to an ounce to the pint. It has a wide range of application, and may be applied as alum is in the form of powder diluted with sugar.

Though called an alum, this salt contains no alumina; it is similar to the double sulphate of potassium and iron, which is called *iron alum*, though this is more soluble.

Liquor Ferri Citratis, U. S. P.

Take of Citric acid, in coarse powder, five troyounces and three hundred and sixty grains.
Solution of tersulphate of iron, a pint.
Water of ammonia, twenty fluidounces.
Distilled water, a sufficient quantity.

To the water of ammonia, mixed with 2 pints of distilled water, add the solution of tersulphate of iron, previously mixed with 2 pints of distilled water, stirring constantly; transfer the precipitate formed to a muslin strainer, and wash it with water until the washings are nearly tasteless. When the precipitate is drained, put half of it in a porcelain capsule on a water-bath heated to 150°, add the citric acid, and stir the mixture until the precipitate is nearly dissolved. Then add so much of the reserved precipitate as

may be necessary fully to saturate the acid. Lastly, filter the liquid, and evaporate it, at a temperature not exceeding 150°, until it is reduced to the measure of a pint.

The above process, which occurs under the head of Liquores in the *Pharmacopœia*, consists in the precipitation of hydrated sesquioxide of iron, washing the magma with water, and combining it with an equivalent of citric acid forming a clear solution, which is to be evaporated to a pint for each eight troyounces of the contained salt. This solution is convenient to keep on hand for dispensing, and for compounding the various liquid preparations containing the citrate. This salt is more soluble when freshly prepared than when old, and although it is slowly and imperfectly soluble in cold water, under ordinary circumstances, it is readily obtained and kept in this concentrated solution, which, being of known strength, may be readily diluted to the point desired.

Ferri Citras. $Fe_2\overline{Ci}=322$. (*Citrate of Sesquioxide of Iron. Ferric Citrate.*)

Of the several citrates of iron, the acid citrate of the sesquioxide is most commonly used. It is made by evaporating the officinal solution as above, to the consistence of a syrup, and spreading it on glass or porcelain plates, where it speedily dries in thin layers, which are separated and broken into fragments. If evaporated at too high a temperature, it is apt to become adhesive, and cannot be separated in scales.

It is in beautiful garnet-red colored plates, slightly soluble in cold water, readily in boiling, and has an acid ferruginous taste. Dose, gr. iij to v.

Ferri et Ammonii Citras. (*Citrate of Iron and Ammonium.*)

Take of Solution of citrate of iron, a pint.
Water of ammonia, six fluidounces.

Mix the solution of citrate of iron with the water of ammonia, evaporate the mixture at a temperature not exceeding 150° to the consistence of syrup, and spread it on plates of glass so that in drying the salt may be obtained in scales. (*U. S. P.*)

This salt differs but little from the foregoing; the presence in it of a notable proportion of citrate of ammonium renders it more soluble than the acid citrate; it is in garnet-red translucent scales; it does not change the color of litmus or turmeric, and does not yield a precipitate with ferrocyanide of potassium. It may be distinguished from the acid citrate by giving off ammonia on the addition of solution of potassa; they both throw down hydrated sesquioxide of iron on this addition.

Ferri et Quiniæ Citras. (*Citrate of Iron and Quinia.*)

Take of Solution of citrate of iron, ten fluidounces.
Sulphate of quinia, a troyounce.
Diluted sulphuric acid,
Water of ammonia,
Distilled water, each, a sufficient quantity.

Triturate the sulphate of quinia with six fluidounces of distilled water, and, having added sufficient diluted sulphuric acid to dissolve it, cautiously pour into the solution water of ammonia, with constant stirring, until in slight excess. Wash the precipitated quinia on a filter, and, having added it to the solution of citrate of iron, maintained at the temperature of 120° by means of a water-bath, stir constantly until it is dissolved. Lastly, evaporate the solution to the consistence of syrup, and spread it on plates of glass, so that, on drying, the salt may be obtained in scales. (*U. S. P.*)

In this very simple and practicable formula sulphate of quinia is directed to be dissolved by the aid of sulphuric acid, and the organic alkali is then precipitated from it by ammonia; this is then combined with the excess of citric acid in the acid citrate of iron, and the mixed salt dried in scales in the usual way.

This very popular preparation, as met with in commerce, is of uncertain strength, partly in consequence of there having been, until the publication of the recent edition of the *Pharmacopœia*, no authoritative formula for its preparation; the composition of the officinal article, founded on the relative doses of its two principal ingredients, is five grains of citrate of iron to one of citrate of quinia. It has the bitter taste of the quinia, and is best adapted to use in the form of pill.

It is in thin transparent scales, varying in color from reddish-brown to yellowish-brown, with a tint of green, according to the thickness of the scales. It is slowly soluble in cold water, more readily so in hot water, but insoluble in ether and officinal alcohol. Ammonia, added to the aqueous solution, deepens its color to reddish-brown, and causes a whitish curdy precipitate of quinia, but no sesquioxide of iron is thrown down. The dose is gr. ij to gr. v.

Ferri et Strychniæ Citras. (*Citrate of Iron and Strychnia.*) U. S. P.

Take of Citrate of iron and ammonium, five hundred grains.
Strychnia,
Citric acid, each, five grains.
Distilled water, nine fluidrachms.

Dissolve the citrate of iron and ammonium in a fluidounce, and the strychnia and citric acid in a fluidrachm, of the water. Mix the two solutions, evaporate the mixture by means of a water-bath at a temperature not exceeding 140°, to the consistence of syrup, and spread upon plates of glass, so that the salt, when it is dry, may be obtained in scales.

The proportion suggested by Prof. Procter, as giving a suitable dose of the strychnia with the dose of iron salt usually prescribed, was 1 grain in 49 of the salt. C. A. Heinitsh, of Lancaster, Pa., and Jos. Abel, of Pittsburg, Pa., have since recommended a preparation of about half the proportion of strychnia, 1 part to 100 of citrate of iron, which has been adopted in the *U. S. Pharmacopœia* as above. Used in atonic dyspepsia, chorea, and suppressed menstruation. Dose, 3 to 6 grains.

Ferri et Zinci Citras.

If carbonate of zinc is added to a solution of citric acid, it begins to precipitate an insoluble salt before the point of saturation is attained; this precipitate being collected before it contains an excess of carbonate, and ammonia and citrate of iron added, a dark green solution is formed, which, concentrated and dried on glass, gives brownish-green scales, very soluble in water. The quantity of citrate of iron may be varied from the equivalent proportions, to four parts of citrate of iron and one of citrate of zinc, with a similar product. The latter proportion exists in the "modified wine of iron," of which a formula is given under the appropriate head.

Dose of the double citrate, 1 to 3 grains.

Ferri et Magnesii Citras.

It appears in greenish-yellow scales, which are obtained by dissolving freshly-precipitated sesquioxide of iron in citric acid, saturating with carbonate of magnesium, and evaporating.

It has a sweetish, slightly ferruginous taste, and is soluble in water. It is used in some cases as a mild chalybeate, which is easily assimilated, and is given in doses of from three to twelve grains.

Syrupus Ferri Citratis. (*Syrup of Citrate of Magnetic Oxide of Iron.*)

Take of	Citric acid	℥v.
	Sulphate of iron	℥j.
	Water,	
	Solution of ammonia, of each	Sufficient.
	Sugar	℥viij.

By the process given for liquor ferri tersulphatis, convert one-half of the sulphate of iron into sulphate of the sesquioxide; mix this in solution with the remaining ℥ss of the sulphate, and add the solution of ammonia until it ceases to throw down a precipitate of the black or magnetic oxide. Having collected and washed this, add it to the citric acid, dissolved in f℥j of water, heat to about 150° F. and filter; dilute the filtered liquid with water to make f℥v; in this dissolve the sugar, and a clear dark-colored syrup will be the result.

This contains ℥j of the salt to f℥j (by calculation), and is a very eligible preparation in the dose of ♏xx to f℥j.

Syrupus Ferri Protocitratis. (*Syrup of the Proto-Citrate of Iron.*)

Take of	Sulphate of iron	℥iijss.
	Carbonate of sodium	℥iv.
	Sugar,	
	Water, of each	Sufficient.
	Citric acid	℥ss.
	Simple syrup	f℥iv.

Dissolve the sulphate of iron and carbonate of sodium in equal portions of water, and add the one to the other in a beaker or pre-

cipitating glass. Wash the precipitated protocarbonate of iron with water, in which a small portion of sugar has been dissolved, and add it to a concentrated solution of the citric acid; evaporate to a greenish, deliquescent mass, and dissolve in the syrup. This is a greenish-brown liquid, containing nearly ʒj of the salt to fʒj. Dose, ♏xxx to fʒj. It is liable to deposit the salt by long keeping.

The syrup of citrate of iron of *Beral* is a saccharine solution of the citrate of ammonium and sesquioxide of iron.

Ferri Oxalas. (*Oxalate of Iron*, U. S. P. $Fe\overline{Ox}$.)

Take of	Sulphate of iron . . .	Two troyounces.
	Oxalic acid	Four hundred and thirty-six grains.
	Distilled water . . .	A sufficient quantity.

Dissolve the sulphate of iron in thirty fluidounces and the oxalic acid in fifteen fluidounces of distilled water. Filter the solutions, and having mixed them with agitation, set aside the mixture until the precipitate is deposited. Decant the clear liquid, wash the precipitate until the washings cease to redden litmus, and dry it with a gentle heat.

A lemon-yellow crystalline powder, insoluble in water but soluble in muriatic acid. Heated in contact with the air, it decomposes with a faint combustion, and leaves a residue of not less than forty-eight per cent. of red oxide of iron. This salt of iron is but slightly soluble and has but little disposition to change; it possesses the tonic properties of the iron salts but not their astringency, and is given in doses of two or three grains three times a day. (See *Am. Journ. Pharm.* 1868, 77–111.)

Ferri Phosphas. (*Common Phosphate of Iron.*)

The officinal phosphate of iron is formed by double decomposition between solutions of two equivalents of sulphate of protoxide of iron and one equivalent of phosphate of sodium. Its composition as thus prepared is variable, being a mixture of phosphate of protoxide of iron, and phosphate of sesquioxide in different proportions. Wittstein gives a very full account of it, with specific directions for its preparation. As first precipitated it is white, and is then stated to be nearly pure phosphate of protoxide, $2Fe,H,PO_4$; the reaction is thus represented, $2(Fe,SO_4) + 2Na,H,PO_4 = 2Fe,H,PO_4 + 2(Na,SO_4)$; the soluble sulphate of sodium being washed away and the salt dried, it is found to have acquired a slate color, more or less green, the protoxide of iron having become partially changed, as before stated, into sesquioxide, and combined with phosphoric acid. It is soluble in acids like phosphate of lime, but not in water.

Phosphate of iron has long been in use in medicine for the general purposes to which the ferruginous salts are applicable, though until the recent introduction of several preparations containing it in solution, it has been little known to practitioners. Dose, gr. v to x.

Phosphate of sesquioxide of iron, $Fe_2 3P_2O_4 = 9H_2O$, is the white precipitate occasioned by phosphate of sodium in sesqui salts of iron;

it has been used in medicine in cases like the foregoing, and in similar doses. (See *Phosphate of Iron.*)

Syrup of Superphosphate of Iron.

This syrup is prepared by adding freshly precipitated phosphate of iron to saturation in a boiling solution of glacial phosphoric acid. On concentrating and cooling, it congeals into a soft mass, which is freely soluble in water in all proportions, and free from inky taste.

The syrup is made from this, by dissolving five grains in each fluidrachm of simple syrup. Dose, a fluidrachm or less.

Syrup of Phosphate of Iron and Ammonium. (Joseph Roberts.)

Take of	Sulphate of iron	278 grains.
	Phosphate of sodium	359 grains.
	Glacial phosphoric acid	396 grains.
	Liquor ammoniæ	Sufficient.
	Sugar	5½ ounces.
	Water	Sufficient.

Dissolve the phosphate of sodium and the sulphate of iron separately. Mix the solutions, and wash the resulting precipitate of phosphate of iron. Then to one-half the phosphoric acid dissolved in one ounce of water, add water of ammonia until it is saturated. To the other half of the phosphoric acid dissolved in a like quantity of water, add the moist phosphate of iron and dissolve by a gentle heat, then add the solution of phosphate of ammonium and the sugar, and evaporate to seven fluidounces. This preparation contains 4½ grains of phosphate of iron, 4¾ grains of phosphate of ammonium, and 3½ grains of phosphoric acid, to a fluidrachm or teaspoonful.

It is remarkable for holding the ferruginous phosphate permanently in perfect solution. The dose is a teaspoonful or less.

Parrish's Compound Syrup of Phosphates.

Take of	Protosulphate of iron	ʒx.
	Phosphate of sodium	ʒxij.
	Phosphate of calcium	ʒxij.
	Phosphoric acid, glacial	ʒxx.
	Carbonate of sodium	℈ij.
	Carbonate of potassium	ʒj.
	Muriatic acid,	
	Water of ammonia, of each	Sufficient.
	Powdered cochineal	ʒij.
	Water	Sufficient.
	Sugar	℔ij ʒviij, offic.
	Orange-flower water	fʒj.

Dissolve the sulphate of iron in fʒij of boiling water, and the phosphate of sodium in fʒiv of boiling water. Mix the solutions, and wash the precipitated phosphate of iron till the washings are tasteless. Dissolve the phosphate of calcium in four fluidounces of boiling water with sufficient muriatic acid to make a clear solution; when cool precipitate it with water of ammonia, and wash the precipitate.

To the freshly-precipitated phosphates, as thus prepared, add the phosphoric acid previously dissolved in water; when clear add the carbonates of sodium and potassium, previously dissolved in water, and muriatic acid to dissolve any precipitate. Now dilute with water till it reaches the measure of twenty-two fluidounces, add the sugar, and towards the last, the cochineal; dissolve by the aid of heat, strain, and when cool add the orange-flower water.

As thus made, each teaspoonful contains about two and a half grains of phosphate of calcium, one grain of phosphate of iron, with fractions of a grain of phosphates of sodium and potassium, besides free phosphoric and hydrochloric acids. The solution is perfect, the taste agreeably acid, and the flavor pleasant. The disposition to precipitate a bulky sediment of the insoluble phosphates is one of the greatest annoyances in this preparation, when made on a large scale, and can be obviated best by substituting hydrochloric acid for a suitable portion of the phosphoric acid used, taking care to separate the liquid into two portions, and adding the carbonate of sodium and potassium to that consisting exclusively of the phosphoric acid solution, lest portions of chloride of sodium and chloride of potassium should be formed and contaminate the resulting solution.

Owing to the uncertain strength of phosphoric acid of commerce, being a mixture of the monobasic, bibasic, and tribasic acids, as described under that head, and always being contaminated with earthy phosphates, there is some uncertainty about the proportions to be employed in the above formula. These considerations have induced the trial of a method by double decomposition, which should always furnish a uniform strength of acid from a cheap and accessible source.

E. Scheffer, of Louisville, Ky., has proposed to take 49.25 drachms of phosphate of calcium, 34.125 monohydrated sulphuric acid, diluted with three times its weight of water, put them in a thin dish and heat on a water-bath for half a day. By this process only 37.25 drachms of phosphate of lime will be decomposed by the sulphuric acid, which combines with the lime of these 37.25 drachms to form sulphate of calcium, while the phosphoric acid is set free and holds the other twelve drachms of phosphate of calcium in solution. After it has cooled, the magma is pressed, macerated with fresh water, and again pressed, and the liquid evaporated, if necessary, to twenty fluidounces, cooled, and filtered. The phosphate of iron and carbonates of potassium and sodium are now added as in my own recipe, and the whole made into a syrup *secundum artem*.

The washing of the precipitated sulphate of calcium is best performed in a funnel, the water being thrown upon the middle in a kind of reservoir formed by raising the precipitate on the sides of the funnel; the last portions are collected separately and evaporated until, with the stronger portion, they have the desired measure.

Dr. Joseph G. Richardson, of Philadelphia, has proposed to use citric acid as the solvent for the phosphates in the compound syrup;

this substitution, though probably modifying the therapeutic properties of the preparation, furnishes it in a very agreeable form. His recipe from the *American Journal of Pharmacy*, vol. xxx. p. 19, was published in the second edition of this work.

Under the synonym of "Chemical Food," this preparation has attained a wide popularity with the medical profession, both in the United States and in Great Britain. When skilfully made, it is one of the most agreeable, as it is certainly one of the most efficient, of the chemical nutritive tonics, which, in accordance with improved methods of treating chronic diseases, have become so desirable to the physician.

The excess of acid, though in a few cases disagreeing with the stomach, is perhaps generally useful in promoting the efficiency of the medicine, as a tonic, to the digestive function; it may be avoided when objectionable, by presenting the insoluble phosphates in a hydrated form, as suggested by Prof. Procter, thus:—

Syrups of the Undissolved Phosphates.

Take of Protosulphate of iron (cryst.) . . . . . ʒij.
Chloride of calcium (fused) . . . . . ʒiss.
Phosphate of sodium (cryst.) . . . . . ʒvij.
Syrup of ginger,
Distilled water, of each . . . . . fʒiv.

Triturate the chloride of calcium with the phosphate of sodium and three fluidounces of the water, till the decomposition is complete and a smooth mixture is obtained, then add the syrup, and finally the sulphate of iron, previously dissolved in a fluidounce of the water. The resulting mixture consists of the hydrated phosphates of iron and calcium, with about two drachms of sulphate of sodium, and a little common salt, the whole suspended and rendered palatable by the syrup.

Ferri Pyrophosphas. $2Fe_2 3P_2O_7 + 2NH_4\overline{Cl} + 13Aq.$

Take of Phosphate of sodium, seven troyounces and a half.
Solution of tersulphate of iron, seven fluidounces, or a sufficient quantity.
Citric acid, two troyounces.
Water of ammonia, five fluidounces and a half, or a sufficient quantity.
Water, a sufficient quantity.

Heat the phosphate of sodium, in a porcelain capsule, until it undergoes the watery fusion, and continue the heat until it becomes dry. Transfer the dry salt to a shallow iron capsule, and heat it to incipient redness, without fusion. Then dissolve it in three pints of water, with the aid of heat, and, having filtered the solution and cooled it to the temperature of 50°, add solution of tersulphate of iron until this ceases to produce a precipitate. Stir the mixture thoroughly, and pour it upon a muslin strainer, and, when the precipitate has drained, wash it with water until the washings pass nearly tasteless, and transfer it to a weighed porcelain capsule.

To the citric acid, contained in a suitable vessel, add water of

ammonia until the acid is saturated and dissolved. Then add the solution to the precipitate in the weighed capsule, stir them together, and evaporate until the liquid is reduced to sixteen troyounces. Spread this on plates of glass or porcelain, so that, on drying, the salt may be obtained in scales. Lastly, preserve it in a well-stopped bottle, protected from the light. (*U. S. P.*)

When the officinal phosphate of sodium is heated to redness it undergoes a change, the phosphoric acid it contains being converted into bibasic phosphoric acid, so that by recombination it will furnish a different class of salts; the first step in the above formula is designed to produce this change. After expelling the water of crystallization, the heat is raised to incipient redness to expel the water of hydration (basic water), *pyrophosphate of sodium* being produced; this is anhydrous, and soluble with difficulty unless by heat; when crystallized from its solution it combines with ten equivalents of water. In making the salt directly from pyrophosphate of sodium the quantity should be about three troyounces of the anhydrous, or five troyounces of the crystallized salt, instead of seven troyounces and a half of ordinary phosphate of sodium ordered in the recipe. It now remains to form the bibasic salt of iron; by precipitating solution of tersulphate of iron with the pyrophosphate of sodium, taking care to operate at a temperature below 50° F., we obtain a gelatinous precipitate, which has the property of dissolving with facility in citrate of ammonium; this ingredient, as formed by the direct union of its elements, is accordingly added, and the solution evaporated till of suitable consistence to be spread on plates of glass to dry; as thus prepared it is in thin apple-green scales, having a slightly saline (not metallic) taste, wholly and freely soluble in water; it consists of about one-half pyrophosphate of iron, one-third citrate of ammonium, and the remainder water.

The composition given at the head of this article is inferred by Dr. Squibb from the ingredients and proportions used in its preparation, and is not the result of analysis, a remark which applies to other formulæ given in this and similar works. Much of the pyrophosphate of iron that is met with in commerce is imperfectly soluble.

This preparation has come into very extensive use within the past few years, having been first brought into view as a remedial agent by M. Robiquet. The officinal formula is a modification of that of Dr. Squibb, published in the *Am. Journ. of Pharm.*, 1860, p. 36; to which accurate and reliable chemist we are indebted for much that is known of its properties.

It is remarkably well adapted to those delicate conditions of the system in which iron is so often indicated, and has the great merit of being free from the ferruginous taste. The presence of the citrate of ammonium sometimes reproduces a tendency to diarrhœa in cases of great susceptibility of the mucous membrane, as in late stages of phthisis; it may then be combined with astringents, but generally the absence of astringency is a great recommendation of this salt. The dose is five grains.

Syrup of Pyrophosphate of Iron.

The difficulty of procuring the pyrophosphate perfectly soluble, or rather the fact that the article as found in commerce is so generally deficient, makes it desirable that the pharmacist should prepare the syrup from the ingredients as given in the officinal formula for the salt; that the process may be shortened where it is intended to convert the salt into the form of syrup, Dr. Squibb recommends that the solution resulting from the addition of the solution of citrate of ammonium to the magma of freshly precipitated pyrophosphate of iron, as evaporated ready for drying on glass, should be added to simple syrup; the following proportions sufficiently approximate the required dose.

Take of Solution of pyrophosphate of iron	2 fluidounces.
Syrup	1 pint.

Mix them (add flavor to taste).

Dose, a fluidrachm.

If a pure and soluble article of the pyrophosphate of iron in scales is at hand, it may be dissolved in simple syrup in the proportion of sixteen grains to the fluidounce, which will nearly correspond with the above.

Hypophosphites of Iron.

There are two hypophosphites of iron in use in the preparations which follow, hypophosphite of sesquioxide (ferric hypophosphite), $Fe_2 3PO_2$, as suggested by Prof. Procter, and hypophosphite of protoxide (ferrous hypophosphite), $Fe2HPO_2$, proposed by W. S. Thompson, of Baltimore. The first named is prepared by precipitating a solution of hypophosphite of sodium or ammonium with solution of sesquisulphate of iron. It is necessary to avoid the presence of an alkaline carbonate, or the precipitate will be contaminated with free sesquioxide of iron. After washing the gelatinous precipitate thrown down by the mixed liquids, which must be done with care, as in this state it is soluble, it may be dried into an amorphous, tasteless white powder, freely soluble in hydrochloric and hypophosphorous acids.

The hypophosphite of protoxide of iron is present in two of the syrups for which recipes are given below, and is recommended in this form of preparation by being more permanent than the sesquisalt, which, as observed by W. S. Thompson, continually tends to pass into proto-salt in saccharine solution; the proto-salt is also more soluble; it is, I believe, not met with in commerce in a solid form.

Syrup of Hypophosphite of Iron. (*Containing Ferrous Hypophosphite.*)

Take of Protosulphate of iron	185 grains.
Carbonate of sodium	240 grains.
Hypophosphorous acid (sp. gr. 1.036)	3½ ounces.
Water	A sufficient quantity.
Sugar	12 ounces.

Dissolve the sulphate of iron and carbonate of sodium, each separately, in four fluidounces of water, and mix the solutions. Wash the precipitated carbonate of iron thoroughly with sweetened water, and drain it on a muslin filter; then transfer to a dish, add a small portion of water, heat gently, adding hypophosphorous acid till it forms a clear solution; then add water till it reaches eight fluidounces, and add the sugar and flavor to taste. The dose of this is a fluidrachm.

Thompson's Syrup of Hypophosphites. (*Containing Ferrous Hypophosphite.*)

Take of Hypophosphite of calcium	256 grains.
Hypophosphite of sodium	192 grains.
Hypophosphite of potassium	128 grains.
Protosulphate of iron, crystallized	185 grains.
Carbonate of sodium	240 grains.
Hypophosphorous acid (sp. gr. 1.036)	3½ fl. ounces.
Sugar	12 ounces.

Dissolve the protosulphate of iron and carbonate of sodium, each separately, in four fluidounces of water, and mix the solutions. Wash the precipitated carbonate of iron thoroughly with sweetened water, and drain it on a muslin filter. Having placed the salts of calcium, sodium, and potassium in a suitable porcelain dish, add about two fluidounces of water, and one fluidounce of hypophosphorous acid; heat the mixture gently, and add the moist carbonate of iron, in small portions, from time to time, alternately with the hypophosphorous acid, until the solution is complete. Add water enough to make the whole measure ten fluidounces; pour it into a bottle containing the sugar, and agitate as before. Dose, a fluidrachm. (*Journ. and Trans. of Maryland College of Pharmacy*, June, 1858.)

Procter's Compound Syrup of Hypophosphites. (*Containing Ferric Hypophosphite.*)

Take of Hypophosphite of calcium	256 grains.
Hypophosphite of sodium	192 grains.
Hypophosphite of potassium	128 grains.
Hypophosphite of iron* (recently precipitated)	96 grains.
Hypophosphorous acid solution	q. s. or 240 grains.
White sugar	9 ounces.
Extract of vanilla	½ ounce.
Water	A sufficient quantity.

Dissolve the salts of calcium, sodium, and potassium in six ounces of water; put the iron salt in a mortar, and gradually add solution of hypophosphorous acid till it is dissolved; to this add the solution of the other salts, after it has been rendered slightly acidulous with the same acid, and then water, till the whole mea-

* This quantity, 96 grains, of hypophosphite of iron is obtained when 128 grains of hypophosphite of sodium, dissolved in two ounces of water, is decomposed with a slight excess of solution of tersulphate of iron, and the white precipitate well washed on a filter with water.

sures twelve fluidounces. Dissolve in this the sugar, with heat, and flavor with the vanilla. Dose, a fluidrachm.

Without flavoring, this syrup is not unpleasant.

Among the preparations of lime and of manganese the reader will find other eligible combinations containing hypophosphorous acid, and, in fact, the above are less prescribed than those which do not contain iron, the acid ingredient itself being possessed of those *hæmatogen* properties which are sought in this class of tonics.

Ferri Lactas. $Fe\bar{L}+Aq$? U. S. P.

Take of Lactic acid, a fluidounce.
Iron, in the form of filings, half a troyounce.
Distilled water, a sufficient quantity.

Mix the acid with a pint of distilled water in an iron vessel, add the iron, and digest the mixture on a water-bath, supplying distilled water, from time to time, to preserve the measure. When the action has ceased, filter the solution, while hot, into a porcelain capsule, and set it aside to crystallize. At the end of forty-eight hours, decant the liquid, wash the crystals with a little alcohol, and dry them on bibulous paper. By evaporating the mother-water in an iron vessel to one-half, filtering while hot, and setting the liquid aside, more crystals may be obtained. (*U. S. P.*)

By this new officinal process the iron filings are oxidized into protoxide of iron, which combines with the lactic acid, yielding this salt, which, being rather insoluble, separates in greenish-white crystalline crusts or grains of a mild, sweetish, ferruginous taste, soluble in forty-eight parts of cold, and twelve of boiling water, but insoluble in alcohol.

Exposed to heat it froths up, gives out thick, white, acid fumes, and becomes black, sesquioxide of iron being left. If it be boiled for fifteen minutes with nitric acid, of the specific gravity of 1.20, a white granular deposit of mucic acid will occur on the cooling of the liquid.

Lactate of iron has the advantage of less solubility than some of the other salts, and hence a less powerful taste; it is regarded as a superior preparation, on the supposition that all the combinations of iron are converted into lactates upon their entrance into the stomach. It has been incorporated with flour in the preparation of bread, and is well adapted to the form of lozenge, of chocolate drops, etc.

The lactate has been found beneficial in chlorosis, and the kindred forms of disease, in which iron is indicated, and is said to possess a marked influence upon the appetite. Dose, gr. j to gr. v, repeated at suitable intervals.

Ferri Acetas. (*Acetate of Iron.*)

The *Dublin Pharmacopœia* directs a tincture of this salt, prepared by double decomposition between tersulphate of iron and acetate of potassium, in alcoholic solution, and removing the crystal-

line precipitate of sulphate of potassium; it has a deep-red color, and a strong ferruginous taste.

A much pleasanter preparation is the *Tinctura ferri acetatis, ætherea*, of the *Prussian Pharmacopœia*, which, as a first step, orders an aqueous solution of this salt, *Liquor ferri acetatis*, prepared by dissolving fresh sesquioxide of iron in acetic acid, so that the solution contains 8 per cent. of iron, or 11.43 of oxide of iron, and has a sp. gr. of 1.143.

To make the ethereal tincture, nine ounces of this liquor, two ounces strong alcohol, and one ounce (all by weight) of acetic ether, are mixed. It is a very agreeable preparation, and largely employed in Europe in doses of about ʒss.

Duflos has proposed a basic acetate as an antidote to arsenious and arsenic acid, especially when combined with alkalies. It is prepared by completely saturating acetic acid with sesquioxide of iron. The solution contains $Fe_2,\overline{Ac}$, and in cases of poisoning by arseniates or arsenites, is to be freely used, largely diluted with warm water.

Rademacher's tinctura ferri acetici is prepared by boiling an intimate mixture of 2 oz. 7 dr. protosulphate of iron, 3 oz. acetate of lead, 6 oz. of distilled water, and 12 oz. wine-vinegar, in an iron vessel, and, after cooling, adding 10 oz. alcohol. This mixture is set aside for several months, and when it has assumed a deep-red color, is filtered and preserved. Age improves this tincture in taste and smell. It is used in the same cases as other mild ferruginous preparations, in doses of from thirty to sixty drops.

Ferri Tannas. (*Tannate of Iron, Ferric Tannate.*)

All sesquisalts of iron, if not too acid, are precipitated by tincture of galls or tannic acid; the precipitate is of a bluish-black color, insoluble in water, and tasteless. It has been highly recommended as a chalybeate, which is well adapted to weak stomachs. Dose, in chlorosis, ten grains or more.

A syrup has been proposed, containing $2\frac{1}{2}$ drachms citrate of iron, 1 drachm extract of galls, to 4 ounces raspberry syrup, and twelve ounces simple syrup. The dose is a tablespoonful several times a day.

Ferri Valerianas. (*Valerianate of Iron.* $Fe_2 3\overline{Va}$.)

This preparation is made by the decomposition of valerianate of sodium by tersulphate of iron; it is a dark red amorphous powder, having a faint odor and taste of valerianic acid. It is insoluble in cold water, decomposed by hot water, and is soluble in alcohol. In hysterical affections complicated with chlorosis, it is prescribed in doses of about a grain repeated several times a day.

Ferri et Potassii Tartras. $K,Fe_2\overline{T} + Aq$? (*Tartrate of Iron and Potassium.*)

This double salt is directed to be prepared by heating together, to 140° F., hydrated sesquioxide of iron from one pint of solution

of tersulphate with seven troyounces of bitartrate of potassium in four pints of water. The excess of tartaric acid in the latter salt is saturated by the ferric oxide, forming an uncrystallizable salt. This is obtained by evaporation in a thick, syrupy liquid, which is poured on plates of glass to dry. As thus prepared, it forms ruby-red scales, having the physical characters of the citrate; soluble in seven times its weight of water, and becoming damp on exposure.

In solution it does not change the color of litmus, and, at common temperatures, does not yield a precipitate with potassa, soda, or ammonia. Ferrocyanide of potassium does not render it blue until an acid be added.

Its astringency is much less than that of the ferruginous preparations generally, and its stimulating influence less obvious. From its slight taste and ready solubility, it is one of the best preparations for children. Dose, gr. x to xx.

Ferri et Ammonii Tartras. $NH_4Fe_2\overline{T}+Aq$? (*Ammonio-Tartrate of Iron.*)

This double salt resembles the foregoing; it is prepared by saturating 6 troyounces of tartaric acid in solution with carbonate of ammonium, then adding 6 troyounces additional of the acid; hydrated sesquioxide of iron from two and a half pints of the solution of tersulphate is now precipitated and washed and added to the solution of bitartrate of ammonium, which is kept at the temperature of 150° until it ceases to take up the oxide. It is then filtered and evaporated to the consistence of syrup, and spread on plates of glass, so that on drying the salt may be obtained in scales.

These are transparent garnet-red, with a "saccharine taste." It is much more soluble than the tartrate of iron and potassium, being slowly dissolved by little more than its weight of water, but is insoluble in alcohol and ether. It is neutral to test paper, not precipitated by the fixed alkalies, nor rendered blue by ferrocyanide of potassium. When incinerated it yields twenty-nine per cent. of sesquioxide of iron.

Ammonio-tartrate is one of the best preparations of iron for common use, especially adapted to children; it is, however, less prescribed than the ammonio-citrate. Dose, gr. x to xx.

Ferri Prototartras. $Fe\overline{T}+4Aq$? (*Prototartrate of Iron. Ferrous Tartrate.*)

Is obtained as a crystalline powder, by digesting iron filings with tartaric acid in solution. It is little soluble in water, has a mild ferruginous taste, and contains 13 per cent. water of crystallization.

It may be used like the other mild forms of iron.

Liquor Ferri Nitratis, U. S. P. (*Solution of Nitrate of Iron. Ferric Nitrate.*)

Take of Iron, in the form of wire cut in pieces, two troyounces and a half.
Nitric acid, five troyounces.
Distilled water, a sufficient quantity.

Mix the iron with twelve fluidounces of distilled water in a wide-mouthed bottle; add to the mixture, in small portions at a time, with frequent agitation, three troyounces of the nitric acid, previously mixed with six fluidounces of distilled water, moderating the reaction by setting the vessel in cold water, in order to prevent the occurrence of red fumes. When the effervescence has nearly ceased, agitate the solution with the undissolved iron until a portion of the liquid, on being filtered, exhibits a pale-green color. Then filter the liquid, and, having poured it into a capacious porcelain capsule, heat it to the temperature of 130°, and add the remainder of the nitric acid. When the effervescence has ceased, continue the heat until no more gas escapes, and then add sufficient distilled water to bring the liquid to the measure of thirty-six fluidounces.

This improved formula from the *Pharmacopœia* is designed to furnish a permanent solution not liable to precipitate the bulky subnitrate upon standing, which, as made by the old process, was invariably the case.

The acid is now directed to be weighed instead of being measured, so that an apparent variation exists in the proportion; this, however, is nearly the same as in the old process, the differences in the old and new formula being in the mode of oxidizing the iron and forming the salt. The protonitrate is first formed by the addition of diluted acid to the iron immersed in a large quantity of water, keeping down the temperature by a cold water-bath; an additional portion of nitric acid is then added after filtration, and the solution heated, which peroxidizes the iron and forms pernitrate, $Fe_2,6NO_3$.

The liquid has a pale amber color, and a sp. gr. between 1.060 and 1.070; it does not afford a blue precipitate with ferridcyanide of potassium. A fluidounce of it should contain from eight to ten grains of anhydrous sesquioxide of iron, combined with nitric acid.

It is used as an astringent in diarrhœa, and in hemorrhages from the bowels, uterus, etc., in individuals of pale and feeble constitutions. As a remedy in dysentery, it probably has no superior. A physician of considerable experience writes: "I regard it as much a specific as quinine is for ague." Dose, ♏v to xv.

Syrupus Ferri Prtotonitratis. (*Syrup of Ferrous Nitrate.*)

Take of Iron wire (card teeth), in pieces . .	Two ounces.
Nitric acid (sp. gr. 1.42)	Three fluidounces.
Water	Thirteen fluidounces.
Sugar, in powder	Two pounds.

Put the iron in a wide-mouthed bottle, kept cool by standing in cold water, and pour upon it three fluidounces of water. Then

mix the acid with ten fluidounces of water, and add the mixture in portions of half a fluidounce to the iron, agitating frequently until the acid is saturated, using litmus paper. When all the acid has been combined, filter the solution into a bottle containing the sugar and marked to contain thirty fluidounces. If the whole does not measure that bulk, pour water on the filter until it does. When all the sugar is dissolved, strain, if necessary, and introduce the syrup into suitable vials, and seal them.

It requires a particular course of manipulation to dissolve iron in nitric acid, without a large portion passing to the higher stage of oxidation. This manipulation is adopted in the first part of the formula for solution of pernitrate of iron as above, and in this formula, the iron is used in excess; care is taken to prevent its peroxidation by the large dilution of the acid, and the refrigeration of the liquid. As thus obtained the solution has a light-greenish color when filtered, and is precipitated of a greenish color by ammonia. It is necessary for the solution to stand on the iron for several hours after the last addition of acid.

This preparation is, I believe, used for nearly the same purposes as the foregoing, though perhaps less distinctly astringent. Dose, ♏v to xv.

Liquor Ferri Hyperchloratis. (*Solution of Perchlorate of Iron.*)

This salt has been recommended in certain forms of disease, on account of the large quantity of oxygen it contains. It is prepared by dissolving sesquioxide of iron in hyperchloric acid. This acid is obtained by distilling from perchlorate of potassium and sulphuric acid, or by the decomposition of the perchlorate with fluosilicic acid. (See works on Chemistry.) The solution contains Fe_2HClO_4. It is given in mucilaginous liquids, in doses of about ten drops.

Preparations of Iron.

(See First Group, page 226.)

2d Group.—*Compounds of Iron with Halogens and Sulphur.*

Name.	Composition, etc.	Dose.	Description, etc.
Ferri chloridum	$Fe_2Cl_6 + 6H_2O$	gr. j to v	Orange-yel'w crystals
Liq. ferri chloridi	Fe_2Cl_6 in Aq. sp. gr. 1.355	.....	
Tinct. ferri chloridi	gr. 59 Fe_2Cl_6 to ℥j	♏ xv	Yellowish-brown.
Spt. ferri chlorati æthereus	.....	♏ xxx	Prussian Ph.
Syrupus ferri chloridi	gr. 15 to ℥j	℥j	
Ferrum ammoniatum	15 per cent. Fe_2Cl_6	gr. v to x	Orange-colored grs.
Ferri ferrocyanidum	Fe_4Fcy_3	"	Pure Prussian blue.
"*Ferri hydrocyanatum*"	.....	gr. j	Poisonous.
Ferri iodidum	FeI_2	gr. ij to v	Decomposes in air.
Syrupus ferri iodidi	gr. 7 FeI_2 to ℥j	♏ xx	Light-green color.
Ferri bromidum	$FeBr_2$	gr. ij to v	Brick-red powder.
Syrupus ferri bromidi	.....	♏ xx	Greenish syrup.
Liquor ferri bromidi	.....	♏ v to x	See *Bromine*.
Ferri sulphuretum	FeS	gr. v	In baths.
Ferri et potassii sulphuretum	$FeS,K_2S_3K_2S_5$	gr. v	In baths.

Ferri Chloridum. $Fe_2Cl_6+6H_2O=433$. (*Chloride of Iron.*)

Take of Iron, in the form of wire, and cut in pieces, two troyounces.
Muriatic acid, twelve troyounces.
Nitric acid, a troyounce, or a sufficient quantity.

To eight troyounces of the muriatic acid, introduced into a two-pint flask, add the iron, and apply a gentle heat until the acid is saturated and effervescence has ceased. Filter the solution, add to it the remainder of the muriatic acid, heat the mixture nearly to the boiling point in a four-pint porcelain capsule, and add nitric acid in successive portions until red fumes are no longer evolved, and a drop of the liquid ceases to yield a blue precipitate with ferridcyanide of potassium. Transfer the liquid to a smaller capsule, evaporate it by a gentle heat, on a sand-bath, until reduced to eight troyounces and three hundred and sixty grains, and set it aside, covered with glass, for several days, in order that it may form a solid, crystalline mass. Lastly, break this into pieces, and keep the fragments in a well-stopped bottle, protected from the light. (*U. S. P.*)

This preparation is made officinal by a simple and readily practicable process in the edition of 1860; by the action of muriatic acid upon metallic iron protochloride results, which, by heating with nitric acid, is converted into sesquichloride (NO_3 yielding oxygen to HCl, and thus evolving Cl, which converts FeCl into Fe_2Cl_6). A gentle heat is directed to prevent the evaporation and decomposition of a portion of the dissolved chloride. The salt, as obtained by this process, is in yellow crystalline masses, very deliquescent and inconvenient to weigh or manipulate with.

It is wholly soluble in water, alcohol, and ether. Its solution in water affords with ammonia a brown precipitate of hydrated sesquioxide of iron, and does not yield a blue one with ferridcyanide of potassium (red prussiate of potassium).

Perchloride of iron has been very highly recommended, especially by the French surgeons, for both internal and external use as an astringent. Internally it is used, chiefly in the form of syrup in intestinal hemorrhages, and as a local hæmostatic it has been chiefly used in solution, known as *Pravaze's solution*, for which an elaborate formula was published in the last edition of this work. By the above officinal process we may prepare the salt with great facility, and from the salt, the solution. The strength of the solution is, moreover, greatly varied for different purposes—from ♏x to ʒij to each fʒj. For internal use gr. j to gr. v may be administered in a spoonful of syrup. In cases of obstinate local hemorrhage it is recommended to apply the soft, deliquesced salt by means of a brush of spun glass, the pointed and softened end of a stick, or other suitable appliance.

Solution of Perchloride of Iron.—The *Prussian Pharmacopœia* directs an aqueous solution of sesquichloride of iron, which contains ten per cent. of its weight of iron; this is probably never used in-

ternally, but kept as a convenient solution for readily obtaining the peroxide of iron, and for the preparation of the following:—

Spiritus Ferri Chlorati Æthereus; Bestucheff's Nervine Tincture; Lamotte's Golden Drops.—It is prepared by mixing one part (by weight) of solution of perchloride of iron with one and a half part of strong alcohol, and one-half part of ether, exposing the mixture in well-corked white bottles to the sun until it becomes colorless, and subsequently allowing it to oxidize again in contact with the air until it has obtained a yellowish color.

It probably contains some chloric ether and acetic acid, and nearly the whole of the iron as a protosalt. This remedy acquired much celebrity during the last century, and is still much used in Europe as a mild ferruginous preparation, agreeably modified by the presence of ether. Its medium dose is ℥xxx.

Syrupus Ferri Chloridi.

Take of Chloride of iron . . . . . Half a troyounce.
Simple syrup . . . . . One pint.

Mix (flavor to taste).

Dose, a teaspoonful, as a tonic and astringent, adapted to weak and relaxed conditions of the stomach and bowels, and to anæmic symptoms generally.

Liquor Ferri Chloridi, U. S. P. (*Solution of Chloride of Iron.*)

Take of Iron, in the form of wire and cut in pieces, three troyounces.
Muriatic acid, seventeen troyounces and a half.
Nitric acid,
Distilled water, each, a sufficient quantity.

Introduce the iron into a flask of the capacity of two pints, pour upon it eleven troyounces of the muriatic acid, and allow the mixture to stand until effervescence has ceased. Then heat it to the boiling point, decant the liquid from the undissolved iron, filter it through paper, and, having rinsed the flask with a little boiling distilled water, add this to it through the filter. Pour the filtered liquid into a capsule of the capacity of four pints, add the remainder of the muriatic acid, and, having treated the mixture nearly to the boiling point, add a troyounce and a half of nitric acid. When effervescence has ceased, drop in nitric acid, constantly stirring, until it no longer produces effervescence. Lastly, when the liquid is cold, add sufficient distilled water to make it measure a pint. Its specific gravity is 1.355.

This is a new officinal in the *U. S. P.* 1870, designed to furnish a solution from which the tinctura ferri chloridi can be readily prepared; the formula is a slight modification of one proposed by Dr. E. R. Squibb, and yields a more uniform preparation than that made from the subcarbonate of iron. One fluidounce of this solution yields a precipitate with ammonia, which, when washed, dried, and ignited, amounts to 113 grains.

Tincture of Ferri Chloridi. Tincture of Chloride of Iron. 1870.

Take of Solution of chloride of iron . . . . . Half a pint.
Alcohol . . . . . A pint and a half.

Mix them and preserve the mixture in a well-stoppered bottle.

In prescribing this tincture it should be remembered that the drops are very small, so that, although its dose is from ten to twenty minims, twice that number of drops may be given. It should not be prescribed with strong mucilage, which it has the property of gelatinizing. It is most frequently presented alone, dropped into water.

It is one of the most popular of the iron preparations. Besides the properties which are common to these, it is astringent, used in passive hemorrhages, and a diuretic which adapts it to a variety of cases. It is also one of the best solvents and vehicles for sulphate of quinia.

Ferrum Ammoniatum. (*Ammoniated Iron. Flores Martiales.*)

Subcarbonate of iron is mixed with muriatic acid in a glass vessel; water and sesquichloride of iron are formed; a solution of the latter is then evaporated along with a solution of muriate of ammonia; a mixture of the two salts is the result, in about the proportions of fifteen per cent. of the former to eighty-five of the latter.

It is met with in the shops in the form of small orange-colored pulverulent grains, sometimes quite crystalline, having a feeble odor and a styptic saline taste. It is deliquescent and soluble in diluted alcohol and water. It also sublimes almost without residue.

In consequence of the small proportion of iron present, it is little esteemed as a chalybeate, and has been omitted from the last two editions of the *Pharmacopœia*. The large amount of muriate of ammonia contained in it renders it alterative, and in large doses aperient. It has been used with advantage in amenorrhœa, scrofula, etc. Also as a deobstruent in glandular swellings. Dose, gr. iv to x.

Ferri Ferrocyanidum. (*Ferrocyanide of Iron. Prussian Blue.* Fe_4Fcy_3.)

Obtained by a double reaction ensuing upon mixture of solutions of ferrocyanide of potassium and solution of tersulphate of iron.

It is an insipid, inodorous substance, in porous cakes, of a rich velvety blue color. Insoluble in water, alcohol, and diluted mineral acids; diluted muriatic acid after boiling on it should yield no precipitate on the addition of ammonia; alkalies decompose it, leaving sesquioxide of iron, and dissolving an alkaline ferrocyanide. Red oxide of mercury, boiled with Prussian blue, affords the soluble cyanide of mercury, with an insoluble mixture of oxide and cyanide of iron.

Tonic and sedative. It has been recommended in intermittent and remittent fever; also in epilepsy and facial neuralgia. Dose, gr. v–xv.

Hydrocyanate of iron is the name given to a preparation manufactured and sold by Tilden & Co. It appears to be a mixed compound of the ferrocyanide of potassium and ferrocyanide of iron, probably made by adding an excess of cyanide of potassium to protosulphate of iron in solution, and either omitting washing it, or washing imperfectly. The dose is smaller than the foregoing; ½ gr. to 1 gr.

An accident resulting fatally is said to have occurred by the substitution of this for the official ferrocyanide.

Ferri Iodidum. FeI_2+Aq. (*Iodide of Iron. Ferrous Iodide.*)

Take of Iodine	℥ij.
Iron filings	ʒj.
Distilled water	Ojss.

Mix the iodine with Oj water, in a glass or porcelain vessel, and gradually add the iron filings, stirring constantly. Heat the mixture gently, until of a light-green color. Filter, and pour upon it the remaining Oss of water, boiling hot. Evaporate the filtered liquor at a temperature not exceeding 212°, in an iron vessel, to dryness. Keep in a closely stopped bottle. One eq. of iron is here made to unite directly with two eq. of iodine, forming an iodide, FeI_2. It is in the form of amorphous masses, containing a small but variable portion of water, exceedingly deliquescent, and possessed of a styptic, chalybeate taste. It is partially soluble in water, imparting to a solution the odor and taste of iodine. By exposure to the atmosphere, it decomposes into free iodine and sesquioxide of iron.

It should be remembered that the proportion of iron in the iodide is small, and that it is a comparatively powerful preparation. Dose, gr. j to ij. Owing to its liability to decompose and its extraordinary deliquescence, it has been omitted from the late edition of the *Pharmacopœia*, and is rarely prescribed, except in the form of the syrup next described, or in that of pilulæ ferri iodidi, introduced among Extemporaneous Preparations.

Syrupus Ferri Iodidi, U. S. P.

Liquor Ferri Iodidi, U. S. P. 1850.

Take of Iodine, two troyounces.
Iron, in the form of wire and cut in pieces, three hundred grains.
Distilled water, three fluidounces.
Syrup, a sufficient quantity.

Mix the iodine, iron, and distilled water in a flask of thin glass, shake the mixture occasionally until the reaction ceases, and the solution has acquired a green color and lost the smell of iodine. Then, having introduced a pint of syrup into a graduated bottle, heat it by means of a water-bath to 212°, and, through a small funnel, the neck of which, when inserted in the mouth of the bottle, passes beneath the surface of the syrup, filter into it the solution already prepared. When this has passed, close the bottle, shake it thoroughly, and, when the liquid has cooled, add sufficient syrup

to make the whole measure twenty fluidounces. Lastly, again shake the bottle, and transfer its contents to two-ounce vials, which must be well stopped.

The present officinal formula for this preparation differs from the foregoing chiefly in containing a larger proportion of sugar, which entitles it to the name of a syrup instead of that of solution as heretofore. It is an instance of the direct union of two elements at ordinary temperatures by contact, which is rendered less rapid and more complete by the intervention of water.

The use of heat, to promote the union of iron and iodine, is unnecessary; the reaction, which is the same as that in the process for making the solid iodide, will take place satisfactorily in the cold.

The result is a solution of the iodide of iron, which is preserved by admixture with syrup; it is a transparent liquid, of a pale-green color, deposits no sediment by keeping, and does not tinge solution of starch blue. Mixed with sulphuric acid it becomes brown, and the mixture emits violet vapors when heated.

The use of sugar as a preservative of this compound is an important improvement, introduced about the year 1830, and has brought this important salt within the reach of the practitioner in a very permanent and eligible form. Iodide of iron produces the valuable effects of the ferruginous salts, in addition to those of iodine; it is peculiarly applicable to the treatment of scrofulous diseases in anæmic patients, and is very much prescribed. This syrup contains about $7\frac{1}{4}$ grains of salt to f℥j. Dose, ♏xx to xl.

It dissolves small proportions of the iodides of mercury, copper, etc., and is incompatible with most chemical agents, but may be mixed with the syrups and fluid extracts of the vegetable alteratives, or, what is perhaps better, prescribed in a separate vial, to be dropped into the syrup at the time of taking it.

A preparation is sometimes prescribed in Philadelphia under the name of *Dr. Hays's Syrup of Iodide of Iron:* the formula is published in the *Amer. Journ. of Med. Sciences* for 1840, p. 449. It is made from 400 grains of iodine, and 160 of iron, and two ounces of sugar to f℥iv. Dose, ♏v.

Ferri Bromidum. (*Bromide of Iron.* $FeBr_2$=136.)

This salt is obtained by adding bromine to iron filings, in excess, under water, and submitting them to a moderate heat. When the liquid assumes a greenish-yellow appearance, it is filtered and evaporated rapidly to dryness in an iron vessel. Bromide of iron is a brick-red, very deliquescent salt, of an acrid styptic taste, and requires to be kept closely stopped in glass vials. This bromide has been used quite extensively in Pittsburg, Pa., as a tonic and alterative, and is considered by some physicians a highly efficacious preparation.

Syrup of Bromide of Iron.

Take of Bromine	200 grains.
Iron filings	85 grains.
Water	4½ fluidounces.
Sugar	3 ounces.

Make a solution in the manner directed for preparing the officinal syrup of iodide of iron. Dose, ℥xx, three times a day, gradually increased. (See *Medical Examiner*, vol. vii. p. 162.)

For the preparation of a solution of bromide of iron with excess of bromine, see Bromine.

Sulphurets of Iron.

Several sulphurets have been proposed, as stimulating alteratives, and as antidotes against the poisonous action of arsenic, lead, mercury, and other metals, which are precipitated by hydrosulphuric acid. As this latter acid may be set free by the intestinal acids, and in larger quantities has itself a poisonous action, the free use of these sulphurets seems to require care.

Ferri sulphuretum, called black sulphuret of iron, is prepared by fusing together iron and sulphur. If well prepared it has a yellowish-gray or blackish color, without odor or taste, and is wholly soluble in diluted acids, with evolution of sulphuretted hydrogen. It is chiefly used for the preparation of this gas, but has been given in scrofulous and chronic skin diseases, in doses of 5 or 10 grains, twice a day.

Ferri et Potassii sulphuretum, prepared by fusing together equal parts of iron filings and carbonate of potassium, with ½ part of flowers of sulphur, is a brown mass, of the odor of sulphuretted hydrogen. It has been recommended as an antidote against arsenic, and also as a powerful alterative in doses of 5 grains, and in larger doses, diluted, in cases of poisoning; externally it has been employed as an addition to baths in the quantity of 1 to 3 ounces.

Manganese. Mn=55.

This is a metal resembling iron in its therapeutical as well as in some of its chemical properties. It forms several oxides, of which the protoxide, MnO, is present in its most important oxysalts, which have a rose color, or are colorless. The salts of protoxide of manganese are not incompatible with vegetable astringents, which is their chief pharmaceutical merit.

Tests for Protoxide of Manganese.—The salts in which protoxide of manganese forms the base are recognized as follows:—

Sulphuretted hydrogen produces in alkalies and sulphuret of ammonium, in neutral solutions, a flesh-colored precipitate of MnS, turning to brown in contact with air, soluble in acids.

Alkalies cause a whitish precipitate of MnO,HO; carbonates of the alkalies a similar precipitate of Mn,CO_3. By exposure to the air, they are partly oxidized, and turn brown.

Carbonate of sodium, fused with compounds of manganese in the outer flame before the blowpipe, assumes from NaO,MnO_3, a green color, turning to a turbid blue green after cooling.

Preparations of Manganese.

Manganesii oxidum nigrum, MnO_2. Native impure mineral.
Manganesii sulphas, $MnSO_4 + 4Aq$. Pale rose-colored crystals, soluble.
Manganesii carbonas, $MnCO_3 + Aq$. Whitish insoluble powder.
Manganesii acetas, $Mn\bar{A}c$. By dissolving carbonate in $\bar{A}c$.
Manganesii lactas, $2Mn\bar{L} + 10Aq$. Dose, gr. j. Rose-colored crystals.
Manganesii phosphas, $3MnHPO_4 + 4Aq$. Dose, gr. j to v. White insoluble powder.
Syr. manganesii phosphatis, gr. v to ℥j. Dose, ſ℥j.
Syr. manganesii hypophosphitis. Dose, ʒss, contains $2\frac{1}{2}$ grs. of the salt.
Manganesii chloridum, $MnCl_2$. Milder than sulphate. Dose, gr. v.
Syrupus manganesii iodidi. Contains ſ℥j to each ſʒj. Dose, ♏ x.
Syrupus ferri et manganesii iodidi. Same strength as syr. ferri iod.
Potassii permanganas, $K_2Mn_2O_8$. Purple crystals, or green powder.

The native impure form of manganese in commerce, that of black oxide, is used to prepare all the rest, it is imported in lumps and in powder, and should have a dark, shining, crystalline appearance; its combining number is 87.

Manganesii Sulphas. (*Sulphate of Manganese. Manganous Sulphate.* $MnSO_4 + 4Aq = 241$.)

This salt may be prepared as follows:—

Mix in a sand crucible the black oxide of manganese with sulphuric acid until of a thick pasty consistence. Cover with a smaller crucible and expose the mixture to a red heat for half an hour. At the end of this interval, remove the crucible from the fire, and when cool reduce the dark brown mass to a coarse powder. Introduce this into a crucible, and saturate as before with sulphuric acid. Again apply heat and continue it till white vapors cease to be expelled. The mass remaining contains the sulphate, which may be obtained impure by solution and evaporation. To purify this from iron, the following directions are given: The filtered solution is to be heated in a porcelain capsule, and when nearly boiling, drop into it carbonate of manganese in small portions at a time until all the iron shall have been precipitated and the liquid changes from a dark red to a pale rose tint. Now evaporate and crystallize. Some processes recommend the heating of black oxide with carbon previous to adding the sulphuric acid, others direct the addition of the moist carbonate to diluted sulphuric acid.

These crystals are of a pale rose color, containing when formed below 42° F. 7Aq, between 42° and 68° 5 Aq, and between 68° and 86° $4H_2O$; they have a styptic taste, are freely soluble in water, and may be given as a tonic in a dose of gr. v; as a cholagogue cathartic, ʒj to ʒij is required. The solution is not disturbed by tincture of nutgall, but affords with caustic alkalies a white precipitate, which soon becomes brown by exposure to the air. Hydrosulphate of ammonium throws down a flesh-colored precipitate, and ferrocyanide of potassium, a white one.

Carbonate of Manganese. $MnCO_3 + Aq = 133$.

This is made by precipitating sulphate with a carbonated alkali, or directly from the native black oxide, as follows:—

Take of black oxide of manganese ℔j, in powder, put it in a porcelain dish on a sand-bath or other source of heat; pour on it muriatic acid Oij, and stir well. Chlorine is evolved, which makes it necessary to operate in the open air or under a chimney. Muriatic acid should be added until it is nearly dissolved. To get rid of free muriatic acid and sesquichloride of iron, add carbonate of sodium, boiling, after each addition, as long as the carbonate precipitated is contaminated with iron, or until a portion of the solution tested with yellow prussiate of potassium does not produce a blue color. The solution of chloride of manganese, being now separated from the oxide of iron by filtration, will furnish, on the addition of an excess of carbonate of sodium, a bulky white precipitate, which, being washed in cold boiled water and dried, constitutes carbonate of manganese.

It is a white or pale rose-colored powder, insoluble in water, and liable to pass into a higher state of oxidation; it may be given in powder, dose, gr. v, or in the form of saccharine powder, or made into a mass with honey.

Manganesii Acetas. $Mn\overline{Ac}$?

By dissolving the carbonate in acetic acid and evaporating, colorless or rose-colored prisms are obtained, which are permanent in the air, have an astringent metallic taste, and are soluble in alcohol, and in three and a half parts of water. It is considered one of the mildest medicinal salts of manganese, and is given in a dose of five grains.

Manganesii Lactas. $2Mn\overline{L} + 10Aq$.

Prepared by dissolving carbonate of manganese in lactic acid, and evaporating; it crystallizes in four-sided prisms of a pale rose-color, is efflorescent, and dissolves in twelve parts of cold water. It has been used together with lactate of iron in doses of one grain, in chlorosis.

Phosphate of Manganese. $3MnHPO_4 + 4Aq$.

This salt is prepared by mixing solutions of sulphate of manganese four parts, and phosphate of sodium five parts, washing the precipitated phosphate till the sulphate of sodium is completely removed, and drying at a moderate heat. It is a white, nearly insoluble powder, and may be made into pills or lozenges, and given in a dose of from one to five grains.

Syrup of Phosphate of Manganese.

Take of	Sulphate of manganese (in crystals) . . .	℥iss, gr. xvij.
	Phosphate of sodium	℥iiss or q. s.
	Muriatic acid	f℥iv.
	Water, q. s. to make	f℥vij.
	Sugar, q. s. to make, with the foregoing . .	f℥xiiss.

Dissolve the salts separately, each in half a pint of water, and add the solution of phosphate of sodium to the solution of sulphate of manganese, as long as it produces a precipitate, which wash with cold water, and dissolve by means of the muriatic acid; dilute till it measures seven fluidounces, then add ten troyounces of sugar, or sufficient to make up the bulk of twelve and a half fluidounces. Each f℥j contains five grains of the salt.

The following have also been occasionally supplied for physicians' prescriptions.

Syrup of Hypophosphite of Manganese.

Take of	Sulphate of manganese	240 grains.
	Hyposulphite of calcium	160 "
	Water	Sufficient.
	Sugar	lbij.
	Orange-flower water	f℥ss.

Dissolve the hypophosphite and sulphate in separate portions of water and mix; then wash the precipitate, evaporate the filtrate to one pint, dissolve in this the sugar by the aid of heat, and add the orange-flower water. Dose, a tablespoonful, containing $2\frac{1}{3}$ grains of hypophosphite of manganese.

Syrup of Iodide of Manganese.

Take of	Sulphate of manganese	℥ij.
	Iodide of potassium	℥ij, ℥iij.
	Sugar	℥xij.
	Water,	
	Syrup, of each	Sufficient.

Dissolve the sulphate and iodide each in f℥iij of cold water, to which f℥ij of syrup have been added, mix them in a glass-stoppered bottle, and, after the crystals of sulphate of potassium cease to precipitate, throw the solution on a filter of fine muslin, and allow it to pass into a pint bottle containing the sugar; add sufficient water to the filter to bring up the measure of the resulting syrup to exactly a pint. This contains about ℥j of the iodide to each f℥j. Dose, ♏ x. (*Procter's Process.*)

Process of J. Creuse.

Take of	Iodine	1 troyounce.
	Iron filings	360 grains.
	Peroxide of manganese, washed . .	2 troyounces.
	Warm water	q. s. or 6 fluidounces.
	Sulphite of sodium	2 or 3 grains.
	Granulated sugar	9 troycunces.

Pour the water and the iron filings into a glass matrass; add the

iodine in the usual manner for making iodide of iron; when this is completed place the matrass on a sand- or water-bath, and add the peroxide of manganese by small portions, as long as a new addition causes the liquid to assume a deep-red color, becoming light brown by agitation, and bring slowly to ebullition. The liquid is then of a light-brown color, due to some free iodine, but contains no trace of iron, as may be ascertained by means of tinct. of nutgalls. Dissolve the sulphite of soda in a drachm of water, add it drop by drop to the liquid till it is dissolved, filter, wash the precipitate well, evaporate to five fluidounces, and dissolve in it the sugar, so as to obtain ten fluidounces of syrup.

The syrup of iodide of manganese thus obtained is almost free from color, presenting only the characteristic light rosy tint of manganese salts. Its taste is saline and not unpleasant. The strength of it is the same as that of the officinal syrup of iodide of iron, that is, about 7.33 grains of the salt to the fluidrachm.

The following equation may explain the chemical reaction: $3MnO_2 + 4Fe + 3I = 3MnI + 2Fe_2O_3$. But it is in reality more complicated than that. When peroxide of manganese is added to iodide of iron, some iodide of manganese is formed, some iodine set free, and some sesquioxide of iron formed, as this equation shows: $4FeI + 3MnO_2 = 3MnI + 2Fe_2O_3 + I$. The liberated iodine combines then with the excess of metallic iron, forming more iodide of iron, which is again decomposed in the same manner by the peroxide of manganese, and so on *ad infinitum*. This also explains the presence to the end of a slight quantity of free iodine; this quantity, however, is small, as it requires hardly a grain of the sulphite to discolor it. (*The Physician and Pharmacist*, Feb. 1872.)

Sypup of Iodide of Iron and Manganese. (Procter.)

This preparation nearly represents the officinal solution of iodide of iron, and is used for the same purposes, and in the same doses.

Take of	Iodide of potassium	1000 grains.
	Protosulphate of iron	630 grains.
	Protosulphate of manganese	210 grains.
	Iron filings (free from rust)	100 grains.
	White sugar (in coarse powder)	4800 grains.
	Distilled and boiled water	q. s.

Triturate the sulphates and the iodide separately to powder, mix them with the iron filings, add half a fluidounce of distilled water, and triturate to a uniform paste. After standing a few minutes, again add half a fluidounce of distilled water, triturate, and allow it to rest fifteen minutes. A third addition of water should now be made and mixed. The sugar should then be introduced into a bottle capable of holding a little more than twelve fluidounces, and a small funnel, prepared with a moistened filter, inserted into its mouth. The magma of salts should then be carefully removed from the mortar to the filter, and when the dense solution has drained through, distilled or boiled water should be carefully poured on in small portions, until the solution of the iodides is

displaced and washed from the magma of crystals of sulphate of potassium. Finally, finish the measure of twelve ounces by adding boiled water, and agitate the bottle until the sugar is dissolved. The solution of the sugar may be facilitated, when desirable, by standing the bottle in warm water for a time, and then agitating.

Each fluidounce of this syrup contains fifty grains of the mixed anhydrous iodides in the proportion of three parts of iodide of iron to one part of iodide of manganese, and the dose is from ten drops to half a fluidrachm.

For papers on the preparations of manganese and iron, including effervescing powders, lozenges, pills, chocolate, and syrup, see *American Journal of Pharmacy*, vol. xxv. p. 174; also vol. xxii. p. 297.

Potassii Permanganas. $K_2Mn_2O_8$. (*Permanganate of Potassium. Chameleon Mineral.*)

This salt, which is sometimes called *hypermanganate of potassium*, may be made by mixing equal parts of very finely-powdered deutoxide of manganese and chlorate of potassium, with rather more than an equal part of caustic potassa, dissolving in a little water, evaporating to dryness, and exposing to a temperature just short of redness. The mass, on treatment with hot water, yields a deep purple solution of this salt, which on evaporation crystallizes, or, if evaporated to dryness, the salt is obtained as a dark-green powder. The crystals are purple, and dissolve in 16 parts of water.

The uses of this preparation are, internally as a remedy in diabetes, dose three grains three times a day, gradually increased, and externally as a caustic and "deodorizer" in treating foul ulcers. It is applied in powder, dusted on to the part, or in solution, from one to ten grains to the ounce. For the remarkable relations of this salt to ozone, and its uses as a deodorizer, see page 131.

Chloride of Manganese. $MnCl_2 + 2H_2O = 162$.

The residuary liquid obtained in preparing chlorine, by dissolving binoxide of manganese in hydrochloric acid, consists of chloride of manganese contaminated with sesquichloride of iron; to free it of this it should be boiled to expel the excess of the acid, and then boiled with a magma of carbonate of manganese, which precipitates the whole of the iron salt.

It crystallizes in thick tables of a rose color, soluble in water and alcohol; its medical properties are little known, but probably bear relation to those of the sulphate, similar to that of the corresponding salts of iron. Its dose is five grains.

CHAPTER VII.

PREPARATIONS OF COPPER, ZINC, NICKEL, AND CADMIUM.

Cuprum. Cu=63.4. (Copper.)

The properties of metallic copper are generally familiar; it is found native in large masses near the shores of Lake Superior, whence the United States are chiefly supplied. It furnishes, by oxidation and combination with acids, some important medicines, which are also, in excessive doses, corrosive poisons. The best antidote is white of egg, milk, or other bland liquid; magnesia will aid in the case of sulphate, by decomposing that salt. Copper is apt to contaminate stewed fruit, from the use of copper vessels in their preparation; it may be detected by immersing a clean spatula in the suspected liquid, which deposits a film of metallic copper.

Reactions.—The presence of copper is also detected by the following reactions of the solutions of its oxide.

Potassa causes a blue precipitate, and its carbonate a pale green, soluble in an excess of the precipitant in the presence of some organic bodies. If grape sugar is present the clear solution on boiling precipitates red suboxide of copper.

Ammonia precipitates them greenish, an excess redissolves the precipitate with a beautiful blue color.

Sulphuretted hydrogen and sulphuret of ammonium produce a black or deep brown precipitate, soluble in NO_3.

Iodide of potassium causes a white precipitate of Cu_2I; free iodine is liberated at the same time.

Ferrocyanide of potassium causes a brown-red precipitate soluble in alkalies.

Copper Preparations.

Cupri sulphas, $CuSO_4 + 5H_2O$. Blue vitriol. Dose, tonic, $\frac{1}{4}$ gr., emet. gr. v.
Cupri carbonas, $CuCO_3 + CuO,HO$. Pale green color. Dose, gr. v.
Cupri oxidum, CuO. Black color. Dose, $\frac{1}{4}$ to 1 gr.
Cupri nitras, $Cu2NO_3 + 3H_2O$. Blue deliquescent crystals. Dose, $\frac{1}{8}$ to $\frac{1}{4}$ gr.
Cupri chloridum, $CuCl + 2H_2O$. Green soluble needles. Dose, $\frac{1}{16}$ to $\frac{1}{8}$ gr.
Cuprum ammoniatum, $CuSO_4 + H_2O,2NH_4$. Blue amorphous moist powder, or prismatic crystals.
Cupri subacetas, $Cu_2O2\overline{Ac} + 6H_2O$. Verdigris; amorphous green masses. Externally
Cupri acetas, $Cu2\overline{Ac}$. "Distilled verdigris" crystals. Neutral acetate.
Cuprum aluminatum. Lapis divinus.

Cupri Sulphas. $CuSO_4 + 5H_2O = 124.4$. (*Blue Vitriol. Blue Stone.*)

Four methods are in use for obtaining this salt. 1st. By evaporating the waters which flow through copper mines, and which

hold it in solution. 2d. Roasting copper pyrites, lixiviating the residuum to dissolve the sulphate, and evaporating so as to obtain crystals. The S of the pyrites abstracts O from the air, and becomes SO_4, and the Cu uniting forms sulphate of copper. 3d. Another mode is to sprinkle plates of copper with sulphur, which are next heated to redness and plunged into water; the sheets are entirely corroded; a sulphuret is formed, which, by the action of heat and air, gradually passes into a sulphate; this is dissolved in water, and crystals obtained by evaporation. 4th. By dissolving the scales, obtained in the process of annealing sheet copper, in diluted sulphuric acid, evaporating, and crystallizing. The salt is in large, rhombic, blue crystals, with a styptic metallic taste; it contains five equivalents of water. It effloresces slightly in dry air; soluble in water, precipitated by ammonia, but redissolved in an excess, forming a rich blue solution. The impurities contained in it, when in crystals, seldom affect its value as a medicine.

Sulphate of copper is much used as a tonic and astringent (dose gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), and as a prompt and powerful emetic in five-grain doses; as an injection in gonorrhœa, etc., it is dissolved in water in the proportion of 2 to 8 grains to f$\bar{3}$j. A crystal, polished by trituration on a damp cloth, is applied as an astringent to inflamed or granulated eyelids, and to the troublesome ulceration of the mouth which is so common. This method of modifying the shape and surface of this crystal is quite preferable to scraping it with a knife. The crystals, deprived of their water of crystallization by drying, are used to detect water in alcoholic solutions; the slightest trace of water giving a blue color to the cupreous powder.

Tests.—If sulphate of copper contains iron, its precipitate with ammonia leaves a brown residue on being dissolved in an excess of the precipitant.

Zinc is detected by the white precipitate produced by sulphuretted hydrogen in a solution previously precipitated by potassa.

Cupri Carbonas. $CuCO_3 + CuO,HO$. (*Hydrated Subcarbonate of Copper. Mineral Green.*)

Sulphate of copper is precipitated by carbonate of sodium; the precipitate is a pale green tasteless powder, which is to be washed and dried at a moderate temperature.

It has been used in neuralgia in doses amounting to about one drachm (?) in twenty-four hours.

It is wholly soluble in muriatic acid; the solution yields no precipitate with chloride of barium.

Cupri Oxidum. $CuO = 79.4$.

If the carbonate or the nitrate of copper is heated to redness, until it ceases to lose weight, the salt is converted into the protoxide, which is of a fine black color.

This oxide, which is also much employed in elementary organic analysis, has been recommended in preference to the carbonate in

doses of one-quarter to one grain three or four times a day, and for indurated glands, in ointments containing one drachm to the ounce.

It is wholly soluble in dilute muriatic acid, and the solution, after precipitating the copper by sulphuretted hydrogen, and filtering, leaves no residue on evaporation.

Cupri Nitras. $Cu2NO_3 + 3H_2O = 241.5$.

Nitrate of copper is obtained by dissolving copper, its oxide or carbonate, in nitric acid, and evaporating to crystallization, when it crystallizes in deep blue prisms, which are deliquescent and soluble in alcohol. Dissolved in mucilaginous liquids it has been given in doses of one-eighth grain; it is used locally as an injection in gonorrhœa and similar complaints. In substance or in concentrated solution it has been employed as a caustic in ulcerated throat, in syphilis, etc.; from the deliquescent nature of the salt, care is necessary to prevent its spreading.

The solution yields no precipitate with nitrate of barium (SO_4), nitrate of silver (HCl), sulphuric or muriatic acids (lead, etc.).

Cupri Chloridum. $CuCl_2 = 99$.

Muriatic acid dissolves oxide or carbonate of copper; the solution by evaporation yields green needles, which are easily soluble in alcohol and water.

It has been occasionally used as a powerful alterative in doses commencing with $\frac{1}{16}$ grain.

Cuprum Ammoniatum. $CuSO_4,H_2O,2NH_4$. (*Ammoniated Copper. Ammonio-Sulphate of Copper.*)

Sulphate of copper, half a troyounce, and carbonate of ammonium, six drachms, are rubbed together in a glass mortar until effervescence ceases; the ammoniated copper is wrapped in bibulous paper, and dried with a gentle heat. When thus rubbed together, these salts give out part of their water of crystallization, by which the mixture becomes moist, and, at the same time, a portion of the carbonic acid of the sesquicarbonate escapes, producing effervescence, and the compound assumes a deep azure blue color; it should be kept in a well-stopped bottle.

Its composition, as thus prepared, may be stated as above, with a variable excess of carbonate of ammonium. A salt of the above composition is obtained in beautiful blue crystals from a solution of sulphate of copper, precipitated and redissolved by ammonia; if alcohol is poured over the surface and set aside the water is gradually abstracted by the alcohol and the salt crystallizes.

It may be considered pure if it has the proper color, and dissolves in twice its weight of water without residue.

Ammoniated copper is regarded as a tonic and antispasmodic. It is occasionally prescribed in combination with assafœtida in pill. Dose, $\frac{1}{2}$ gr. repeated.

Cupri Subacetas. (*Ærugo. Impure Subacetate of Copper. Verdigris.*)

Made by exposing copper plates to the action of the fermenting refuse of the wine-press, or to pyroligneous acid, when this salt forms on the surface.

It is obtained in powder, or amorphous masses, or consisting of very minute crystals, of variable color, with a peculiar metallic odor, and styptic metallic taste; it is resolved by water into a soluble neutral acetate, and insoluble tris-acetate; when treated with sulphuric acid it gives off acetic acid fumes; from the solution, ammonia precipitates the oxide, but redissolves it when in excess.

Verdigris, as it occurs in commerce, is of variable composition and shade of color. The light green appears to be a mixture of various basic salts, while that of a greenish-blue color has the composition $Cu_2O2\overline{Ac} + 6H_2O$ (Berzelius). It is used exclusively in the shape of ointment.

Verdigris ought to be nearly soluble in dilute acetic acid, and the solution, if precipitated by ammonia, must be wholly taken up by the excess of it.

Cupri Acetas. $Cu2\overline{Ac}$. (*Neutral Acetate of Copper.*)

The neutral acetate is prepared by dissolving the above in dilute acetic acid and evaporating to crystallization. It is met with in commerce under the name of *distilled verdigris*, and occurs in dark green crystals, soluble in 5 parts of boiling water. Rademacher uses a tincture of this salt prepared by double decomposition from 3 ounces sulphate of copper, and $3\frac{3}{4}$ ounces acetate of lead, to 30 ounces (weight) diluted alcohol. But it is scarcely ever prescribed.

Cuprum Aluminatum. (*Lapis Divinus. Lapis Ophthalmicus St. Yves.*)

The *European Pharmacopœias* have a preparation under this name and synonyms, and the *Prussian Pharmacopœia* directs sulphate of copper, nitrate of potassium, and alum, of each two ounces, to be fused by a moderate heat in a copper or earthen vessel, and after mixing in one drachm powdered camphor, the mass is poured out upon a cold slab and kept in well-stoppered bottles. It is used externally, frequently in solution as an astringent eye-wash.

ZINCUM. Zn=65. (ZINC.)

This metal occurs in nature in two principal forms: as a sulphuret, *blende*, and as a carbonate or silicate, *calamine*, from which the metal is extracted, by distilling them with carbonaceous matters. The purest zinc found in commerce is that produced in Bethlehem, Pennsylvania, from the native ore, found in great abundance in that vicinity.

It is a bluish-white crystalline metal, soluble in dilute hydrochloric and sulphuric acids, with evolution of hydrogen, also in nitric acid; melted and dropped into water, it constitutes gran-

ulated zinc. It is used in pharmacy for the preparation of the sulphate, acetate, and chloride, which are officinal, and other salts.

From its salts, oxide of zinc is precipitated by alkalies and their carbonates, white, soluble in an excess of alkali. Sulphuretted hydrogen, from neutral or alkaline solutions, white. Sulphuret of ammonium, white; the last two are insoluble in alkalies, soluble in acids. Ferrocyanide of potassium, white, insoluble in dilute HCl.

Preparations of Zinc.

Calamina. Native, impure carbonate of zinc. A gray, coarse powder.
Tutia. A product of smelting lead ores containing zinc. Slate colored.
Zinci sulphas, $ZnSO_4 + 7H_2O$. Small, white, efflorescent crystals. Emetic, gr. x.
Zinci carbonas præcipitata, $ZnCO_3,2ZnH_2O_2$ (?) A pure white, very light powder.
Zinci oxidum, ZnO. A pure white powder, not effervescing with acids.
Zinci acetas, $Zn2\overline{Ac} + 2H_2O$. Micaceous, freely soluble crystals.
Zinci chloridum, $ZnCl_2$. White, translucent plates or masses. Very deliquescent.
Zinci cyanidum, $ZnCy_2$. White powder, insoluble, poisonous. Gr. $\frac{1}{4}$ to j.
Zinci ferrocyanidum, Zn_2FeCy_6.
Zinci iodidum, ZnI_2. White, deliquescent, caustic.
Zinci lactas, $Zn2\overline{L} + 6H_2O$. White, styptic crystals or plates.
Zinci phosphidum, Zn_3P_2.
Zinci valerianas, $Zn\overline{Va}$. White, pearly scales, soluble in alcohol. Dose, gr. j to ij.

Calamina. (*Calamine. Native Impure Carbonate of Zinc.*)

This mineral is found abundantly in Germany, England, and the United States. It is, however, as recently procured, very impure, and seldom contains a considerable proportion of carbonate of zinc. For use, it must be brought to the condition of an impalpable powder, when it constitutes *calamina præparata* (of the former *Pharmacopœias*).

It is in the form of a pinkish or gray powder, of an earthy appearance. It should be almost entirely soluble in sulphuric acid, and the precipitate thrown down by ammonia and potassa should be redissolved by these reagents. The calcination of calamine drives off a quantity of CO_2 and water, so that little remains except oxide of zinc and earthy impurities. The precipitated carbonate or oxide of zinc may be substituted with advantage.

It is only used externally as a dusting powder and exsiccant, or in the form of cerate as a mild astringent.

Tutia. (*Impure Oxide of Zinc. Tutty.*)

This oxide is formed during the smelting of lead ores containing zinc; it is, as I have seen it, usually in little nodules, like those of prepared chalk, of a bluish or slate color. It is said to be much adulterated, some specimens factitious, and is very properly replaced by the officinal oxide of zinc.

Zinci Sulphas. $ZnSO_4 + 7H_2O = 287$. (*Sulphate of Zinc. White Vitriol.*)

Prepared by dissolving zinc in dilute sulphuric acid, evaporating, and crystallizing. Water is decomposed in the presence of the acid

and metal, hydrogen is liberated, the zinc oxidized, and the oxide formed combines with the sulphuric acid.

A cheaper process lately practised in the U. S. A. Laboratory consists in dissolving zinc white, a nearly pure oxide of zinc, in dilute sulphuric acid and crystallizing.

Usually in small, four-sided colorless prisms of the same form as sulphate of magnesia, possessing a disagreeable, metallic, styptic taste, soluble in $2\frac{1}{2}$ times their weight of water, insoluble in alcohol, slightly efflorescent, precipitated, and again redissolved by ammonia. When heated, it dissolves in its water of crystallization, and by prolonged ignition, the acid is all expelled, and oxide of zinc is left. Six equivalents of water are expelled at 212° F., one equivalent remaining as constitutional water. A hydrate containing only 2 equivalents of water is precipitated as a white powder, when a concentrated solution of sulphate of zinc is mixed with sulphuric acid. (Kuhn.)

Iron is detected by a bluish precipitate with ferrocyanuret of potassium; copper by the dark precipitate with sulphuretted hydrogen; magnesia by the residue left on dissolving it in caustic potassa.

In small doses this salt acts as an astringent and tonic; in large doses, as a quick, direct emetic; externally, as a powerful astringent. It is used as a tonic chiefly in diseases affecting the nervous system, and when gradually increased, tolerance soon becomes established; sometimes it is given as an astringent in chronic passive discharges. As an emetic, it is used when the rapid emptying of the stomach is desired without the production of much depression, as in narcotic poisoning. Externally, in solutions of different strengths, it is employed as a lotion or injection, in ophthalmia, gleet, etc.

Dose, gr. ss to ij in pill. As an emetic, gr. x. The strength of a solution for external employment may be from gr. j to x to f℥j water.

Zinci Carbonas Præcipitata. $ZnCO_3,2ZnH_2O_2$? (*Precipitated Carbonate of Zinc.*)

Solutions of carbonate of sodium and sulphate of zinc, equal parts, are mixed together; and double decomposition takes place; sulphate of sodium is formed in solution, and carbonate of zinc is precipitated as a white flocculent powder, resembling magnesia; it should be frequently washed till the washings are tasteless; the powder is dried by a gentle heat. It must be wholly soluble in diluted acids; impurities are then detected as with oxide. Chemists disagree in regard to its composition; that stated above agrees with some of the best authorities.

Uses same as those of calamine. In the form of the officinal cerate, it is much used as a dressing for burns.

Zinci Oxidum. $ZnO=81$. (*Oxide of Zinc. Flowers of Zinc.*)

This is made by exposing the precipitated carbonate to a low red heat, by which CO_2 is driven off, and the residue is the oxide

of zinc, or by the combustion of the metal in a stoneware crucible, collecting the oxide as it ascends, or a hydrate may be obtained by precipitating a soluble salt with a caustic alkali.

In the solution in nitric acid, the following impurities may be detected:—

Lead or copper, by a black precipitate with sulphuretted hydrogen; cadmium, tin, antimony, or arsenic by a yellowish precipitate by the same reagent; earthy oxides, by the white precipitate with carbonate of ammonium, insoluble in an excess of the precipitant; sulphuric and muriatic acids, by barium and silver salts; iron, by a bluish precipitate with ferrocyanide of potassium.

It is a white or yellowish-white powder, becoming yellow at a high heat, and recovering its whiteness on cooling, without odor or taste; insoluble in water, but soluble in diluted hydrochloric and other acids without effervescence, and in ammonia and potassa.

Oxide of zinc is a tonic, especially to the nervous system; also somewhat astringent; used in chorea, epilepsy, and neuralgia. Locally, it is slightly astringent and desiccant, and constitutes an excellent application to excoriated surfaces, and to chapped or cracked nipples. An ointment of oxide of zinc is officinal.

Zinci Acetas. $Zn2\overline{Ac}+2H_2O=219$. (*Acetate of Zinc.*)

It may be procured in either of the following ways: 1. By dissolving oxide of zinc in acetic acid, and crystallizing the saturated solution. 2. By double decomposition between a solution of sulphate of zinc and a solution of acetate of lead. 3. The officinal process, granulated zinc ℥ix, is added to a solution of ℥xij of acetate of lead in water Oiij, and agitated occasionally till no precipitate is formed on the addition of iodide of potassium. The familiar experiment of forming the "zinc," or lead-tree, leaves this salt in solution. In concentrating the solution to one-fifth its bulk, previously to crystallizing, a little of the acetic acid is apt to be dissipated, and should be replaced by dropping in a small excess of the acid.

Should the crystals be discolored they should be dissolved, the solution heated to ebullition, and successive portions of freshly precipitated carbonate of zinc dropped in until the liquid filters colorless; it may then be acidulated with acetic acid and again set aside to crystallize.

When carefully crystallized, it is in the form of very handsome pearly or silky hexagonal crystals, which effloresce in a dry air. As found in commerce, it is sometimes in white micaceous scales; very soluble in water, moderately soluble in alcohol, and has an astringent metallic taste. When heated, it fuses and gives out an inflammable vapor, having the odor of acetic acid; the mineral acids decompose it with the liberation of acetic acid vapors.

It is used as a topical remedy, in the form of collyrium, in ophthalmia, and as an injection in gonorrhœa, gleet, leucorrhœa, etc.

Liquor Zinci Chloridum. $ZnCl_2=136$. (*Solution of Chloride of Zinc. Butter of Zinc.*)

Take of Zinc, in small pieces, six troyounces.
Nitric acid (sp. gr. 1.42),
Precipitated carbonate of zinc, each, one hundred and sixty grains.
Muriatic acid,
Water, each, a sufficient quantity.

To the zinc, in a glass or porcelain vessel, add gradually sufficient muriatic acid to dissolve it; then strain, add the nitric acid, and evaporate to dryness. Dissolve the dry mass in water, add the precipitated carbonate of zinc, and agitate the mixture occasionally during twenty-four hours, then filter through paper, adding enough distilled water through the filter to make the liquid measure a pint.

This beautiful preparation is well prepared by the above process of the *Pharmacopœia*. The chloride of zinc being first formed by the action of the muriatic acid on the metal, the next step is to separate the iron derived from the muriatic acid and from the zinc; this is done by the use of nitric acid, which peroxidizes the iron, and, on evaporation to dryness, dissolving, treating with precipitated carbonate of zinc, and filtering, the peroxide is left behind.

Zinci Chloridum, U. S. P.

Take of Solution of chloride of zinc, a convenient quantity.

Evaporate the solution to dryness in an evaporating dish, fuse the dry mass, pour the liquid on a flat stone, and when it has congealed break the mass into pieces, and keep the fragments in a well-stopped bottle.

A white deliquescent salt, wholly soluble in water, alcohol, and ether. Its aqueous solution yields, with nitrate of silver, a white precipitate, insoluble in nitric acid. It forms white precipitates with ferrocyanide of potassium and hydrosulphate of ammonium.

The final concentration of the liquid requires care, as, by pushing the heat too far, the chloride is decomposed, and contains a portion of insoluble subchloride or oxide; on the other hand, care must be taken to free it entirely of water, otherwise it will not harden into solid and dry masses. The proper point is ascertained by dipping into it a glass rod, on which it should thicken into a hard, dry condition. The mass, in its fused condition, is poured on to a dry marble slab, and, when nearly cool, is broken into fragments, and put immediately into dry salt-mouth bottles, usually of ℥j capacity.

A mixture of chloride, with a sufficient quantity of oxide of zinc, forms a good filling for teeth, becoming very hard by time.

It is used as a powerful escharotic, and as a remedy for toothache. In solution, it is an antiseptic, especially adapted to dissecting-room purposes; it is convenient to employ a solution of zinc in muriatic acid, without either purifying or concentrating it.

The following solution is a good antiseptic for this purpose:—

Take of Zinc	℔ iv.
Hydrochloric acid	℔ iv or q. s.
Water	9 quarts.

Dissolve, avoiding excess of acid. The solution contains about one part of chloride of zinc in twelve.

Zinci Cyanidum. $ZnCy_2 = 119$. (*Cyanuret of Zinc.*)

Prepared by double decomposition between solutions of cyanide of potassium and sulphate of zinc, or by conducting gaseous hydrocyanic acid into a solution of acetate of zinc. The latter is the better process.

It is a brilliant white powder, insoluble in water, soluble in dilute mineral acids; it is tasteless and inodorous, but, when triturated, the odor of prussic acid is given off.

It combines the properties of hydrocyanic acid with those of zinc, and has been used in epilepsy, chorea, and similar diseases, in doses of one-half to one grain.

It is wholly soluble in muriatic acid, precipitated white by carbonate of ammonium, dissolved again in an excess; and in this solution no precipitate is caused by phosphate of sodium; a white precipitate by sulphuret of hydrogen.

Zinci Ferrocyanidum. (*Ferrocyanuret of Zinc.* Zn_2FeCy_6.)

This salt has sometimes been mistaken for the cyanide of zinc, and care is necessary to distinguish them, as the cyanide is poisonous in the medicinal doses of the ferrocyanide. This is prepared by precipitating sulphate of zinc by ferrocyanide of potassium.

It is a white powder, similar in appearance to the former but little soluble in boiling muriatic acid. It has been used in similar complaints in doses of two grains and more.

It may be considered pure if it is of a purely white color, and yields nothing to cold muriatic acid.

Zinci Iodidum. $ZnI_2 = 319$.

Two parts iodine, one part zinc, and four parts water, are digested until the color of iodine has disappeared; after filtration, it is evaporated until, when poured upon a cold slab, it hardens; a little iodine has then been expelled.

It is in white, very deliquescent pieces, forming a turbid solution with water and alcohol. It should be wholly soluble in carbonate of ammonium.

It is caustic and poisonous, and used only topically in aqueous solution, or in ointments, containing gr. xv to xxx to the ounce.

Zinci Lactas. $Zn2\overline{L} + 6H_2O = 351$. (*Lactate of Zinc.*)

The lactate is prepared by dissolving carbonate of zinc in lactic acid, or by double decomposition between hot concentrated solutions of lactate of potassium or calcium and chloride of zinc.

It crystallizes in four-sided prisms, of an acid reaction, and a

sour styptic taste; they require 58 parts of cold water for solution, and are nearly soluble in alcohol.

It is used in epilepsy in doses of two grains three times a day, gradually increasing the dose.

Zinci Phosphidum. $Zn_3P_2 = 257$.

This is to be prepared, according to Proust, by passing a mixture of phosphide of hydrogen and nitrogen through a porcelain tube, heated to redness, containing a porcelain tray upon which is placed metallic zinc. The nitrogen is obtained by heating a mixture of chloride of ammonium and nitrate of potassium, and the phosphide of hydrogen from phosphide of calcium and muriatic acid. It is spongy or crystalline, with vitreous fracture, easily pulverizable, and gives off phosphide of hydrogen by contact with acids. The nitrogen counteracts the inflammability of the phosphide of hydrogen in the process.

Zinci Valerianas. $Zn\overline{V}a = 166$. (*Valerianate of Zinc.*)

Prepared by decomposing two troyounces and seven drachms of sulphate of zinc with two and a half troyounces of valerianate of sodium in solution at 212° F. On evaporation, crystals of the valerianate collect on the surface, and are skimmed off, washed with cold water to separate adhering sulphate of sodium, and dried; a second evaporation secures a second crop of crystals.

The salt is in pearly scales with a faint valerian odor, astringent metallic taste; soluble in 160 parts of water, and in 60 of alcohol of sp. gr. .833. Its solutions have an acid reaction, and become turbid when heated and clear again on cooling. When the salt is distilled with sulphuric acid, the distillate added to a concentrated solution of acetate of copper does not disturb its transparency.

It is a good deal prescribed, perhaps as much so as any other salt of valerianic acid, being adapted to a variety of nervous affections. Dose, gr. j to ij in pill, repeated at intervals.

Cadmium. Cd = 112.

Cadmium is a rare metal which usually accompanies the zinc ores; it was discovered in 1817 as an impurity in medicinal preparations of zinc. It has a white tin color, a high metallic lustre, is very malleable, and oxidizes slowly in the air; its specific gravity is 8.6. Its salts are isomorphous with the corresponding salts of zinc. Its compound with oxygen is oxide of cadmium, CdO = 128.

Tests for Oxide of Cadmium.—Sulphuretted hydrogen and sulphuret of ammonium cause a bright yellow precipitate, insoluble in an excess; ammonia a white precipitate, easily soluble in excess; potassa and the alkaline carbonates a white insoluble precipitate; zinc precipitates the metal. The compounds of cadmium when mixed with oxalate of potassium and exposed to the inner flame of the blowpipe, produce a brownish-yellow incrustation without any metallic globules.

Preparations of Cadmium.

Cadmii sulphas, $CdSO_4 + 4H_2O$. Colorless crystals, soluble in water.
Cadmii iodidum, CdI_2. Soluble in alcohol and water.

Sulphate of Cadmium. $CdSO_4 + 4H_2O = 280$.

The metal cadmium is dissolved in nitric acid diluted with an equal bulk of water, by the aid of heat; carbonate of sodium is then added (three parts to two of the NO_4 used), which precipitates the carbonate of cadmium; this is washed until the water passes tasteless, and dissolved in sulphuric acid diluted with water; it is then evaporated and set aside to crystallize.

Sulphate of cadmium is in colorless, prismatic crystals, efflorescent in the air, and very soluble in water. Its solution, even when rendered decidedly acid, yields, on the addition of hydrosulphate of ammonium, a yellow precipitate, insoluble in an excess of the precipitant.

It is used almost exclusively in nervous and inflammatory diseases of the eye and ear, in solutions containing a grain to an ounce or two of rose-water, or in ointments, about five grains to a drachm of ointment; for injections to the ear, somewhat stronger.

Iodide of Cadmium. $CdI_2 = 366$.

This salt has been proposed as a substitute for iodide of lead, the intense yellow color of which is sometimes objectionable, as liable to discolor the skin. It is prepared by dissolving iodine with granulated cadmium under water, and evaporating the solution, when the salt crystallizes in colorless six-sided tabular crystals, soluble in alcohol and water, and fusible on the application of heat. It is extensively used in photography.

C. L. Heinitsh, of Lancaster, proposes an ointment containing ℈j of the salt to ʒj of lard, perfumed with oil of neroli. He triturates the iodide with 20 drops of ether till in fine powder, then mixes with the lard.

Nickel. Ni = 58.

This is a metal obtained from an ore of arsenic found in Westphalia. It is fixed in the fire, and is hence left behind after the distillation of arsenic, and when purified is found in commerce as a white, hard, malleable magnetic metal, capable of receiving a lustre rivalling silver, sp. gr. 8.82; it is not oxidized by the air, and is little attacked by acids, except in the presence of nitric acid, which dissolves it freely; it forms two oxides, a proto and sesquioxide, the medicinal sulphate being a salt of the protoxide; the protosalts are all of a green color.

Nickel is recognized by the following tests: Caustic alkalies give a pale apple-green precipitate, insoluble in excess, but soluble in solution of carbonate of ammonium, yielding a greenish-blue liquid. Ammonia gives a similar precipitate, soluble in excess, and yielding

a deep purplish-blue solution. Ferrocyanide of potassium gives a greenish-white precipitate. Sulphuretted hydrogen occasions no change in solutions of nickel containing free mineral acids, but in alkaline solutions gives a black precipitate.

Niccoli Sulphas. (*Sulphate of Nickel.* $NiSO_4+7H_2O=280$.)

This salt is formed by dissolving carbonate or oxide of nickel in dilute sulphuric acid, and gently concentrating by evaporation so that crystals may form.

It is in emerald-green prismatic crystals, efflorescent, soluble in 3 parts of cold water, insoluble in alcohol and ether. It has a sweet, astringent taste, composition $Ni.SO_4+7Aq$; crystallized at a higher temperature it contains only 6Aq.

This salt is used as a tonic. Prof. Simpson employed it successfully in a case of obstinate periodic headache. The dose is from $\frac{1}{2}$ grain to 1 grain, three times a day, given in the form of pill or simple solution.

Cobalt. Co=60.

This metal is found, like the foregoing, in ores of arsenic, and the crude mineral, sold as fly-stone by druggists, appears to be an ore containing cobalt and arsenic. The metal itself is white, brittle, strongly magnetic, unchanged in the air, feebly acted on by dilute hydrochloric and sulphuric acids.

Solutions of the salts of cobalt are known as follows: Solution of ammonia gives a blue precipitate, slightly soluble in excess, with a brownish-red color. Solution of potassa a blue precipitate, turning to violet and red when the liquor is heated. Sulphuretted hydrogen produces no change in acid solutions, but with ammonia gives a black precipitate. Melted with borax before the blowpipe, it gives a bead of magnificent blue color.

Protoxide of Cobalt. CoO=76.

This is the only compound used in medicine; it is a powder of an ash-gray color, and has been employed as a remedy in rheumatism. It is formed by precipitation from the nitrate or chloride with carbonate of sodium, washing and igniting. Its chief use is in forming beautiful blue colors in glass, enamels, etc. Its dose as an emetic is 10 grains, as an alterative much less.

CHAPTER VIII.

ON LEAD, SILVER, BISMUTH.

Plumbum. Pb = 207. (Lead.)

Metallic lead is not used in medicine, nor is it officinal for use in preparing any of its salts. It is abundantly diffused in the form of galena, a native sulphuret, which is extensively worked in this country for the production of the metal. Exposed for a long time to its influence, individuals exhibit symptoms of slow poisoning, called lead colic. In over-doses its salts are poisons.

Lead is a soft bluish-colored metal, very malleable and fusible; its properties are familiar to most. It forms five oxides, of which the one most important in a pharmaceutical point of view is the protoxide.

The lead salts show the following reactions:—

A brown or black precipitate by sulphuretted hydrogen and sulphuret of ammonium; a white precipitate by muriatic acid and soluble chlorides, soluble in much water; a yellow precipitate by iodide of potassium, soluble in boiling solutions of alkaline chlorides and iodides; a yellow precipitate by chromate of potassium, scarcely soluble in dilute nitric acid; a gray metallic precipitate by tin and zinc; a white precipitate by ferrocyanuret of potassium.

Preparations of Lead.

Plumbi oxidum (litharge), PbO. Yellow or reddish flakes or powder.
Emplastrum plumbi. See fixed oils, also plasters.
Plumbi oxidum rubrum, Pb_3O_4. Red lead. Bright red powder.
Plumbi acetas, $Pb2\overline{Ac} + 3H_2O$. Matted, acicular crystals, whitish by efflorescence.
Liquor plumbi subacetatis, $Pb_2O\overline{Ac}$ in Aq. A clear heavy liquid, depositing white carbonate.
Liquor plumbi subacet. dilutus. f℥iij liq. plumb. subacet. to Oj.
Plumbi carbonas $2(PbCO_3) + Pb2HO$? A heavy, white, opaque powder.
Plumbi nitras, $Pb2NO_3$. White crystals, soluble in water, disinfectant.
Plumbi iodidum, PbI_2. A bright yellow amorphous powder, used in ointment.
Plumbi chloridum, $PbCl_2$. Flat needle-shaped crystals, used externally.
Plumbi tannas (cataplasma ad decubitum).

Plumbi Oxidum Semivitreum. PbO = 223. (*Semivitrified Oxide of Lead. Litharge.*)

This, which is a common variety of protoxide of lead (PbO), is generally obtained as a secondary product in the cupellation of argentiferous galenas, when the oxide becomes fused or semivitrified, and is driven off in hard particles of a scaly texture. English litharge is the best.

It is in the form of small red or orange-red scales, devoid of smell or taste; soluble, or almost entirely so, in dilute nitric acid. It is occasionally contaminated with iron and copper, and contains a little carbonic acid. If carbonate of lead is present, effervescence takes place with dilute nitric acid; this solution has a green color if copper, and a yellow or brownish color if iron is present.

It is chiefly used for its effect on fixed oils, with which it combines, and hence occasions paint, to which it is added, to dry and harden rapidly. (*See* Emplastrum Plumbi.)

Plumbi Oxidum Rubrum. $Pb_3O_4 = 685$. (*Red Lead. Minium.*)

The yellow protoxide of lead, which is commercially known by the name of massicot, and which differs from litharge in its mode of preparation and properties, though similar in composition, is introduced into a reverberatory furnace, there calcined for 48 hours, heated to redness, and allowed to cool slowly. Or the hot massicot is cooled by being sprinkled with water, and after levigation heated in closed tin boxes to redness; the slower the product is allowed to cool, the finer will be the color.

It is a heavy scaly powder of a bright red color, which appears yellow when rubbed upon paper. Before the blowpipe upon charcoal it is wholly reduced to the metallic state; exposed to the light it is blackened somewhat, by being partially reduced.

Its chief use is as a red paint; it enters into the composition of a few ancient plasters. (*See* Emplastra.)

Plumbi Acetas. $Pb2\overline{Ac} + 3Aq = 325$. (*Saccharum Saturni. Sugar of Lead.*)

Made by dissolving litharge in acetic acid, evaporating the solution, and crystallizing; also by the direct action of vinegar upon sheets of lead partially exposed to the air, so as to become oxidized, when, the oxide being dissolved in the acid, the salt may be obtained in spongy masses composed of interlaced acicular crystals, possessing an acetic odor and a sweet metallic taste; exposed to the air it effloresces slightly, is soluble in twice its weight of cold water, and less of boiling water, communicating a turbidness to the solution from taking up CO_2, which water generally holds; this turbidness may be removed by the addition of a little acetic acid or vinegar.

It is precipitated as a white carbonate by carbonate of sodium; a yellow iodide by iodide of potassium, and a black sulphuret by sulphuretted hydrogen. It is also incompatible with all acids, and with numerous soluble salts. If sugar of lead contains iron, ferrocyanide of potassium will cause a bluish precipitate; if copper is present, the precipitate will have a reddish color.

Sugar of lead is very extensively employed, both internally and externally. It ranks as a sedative astringent, checking morbid discharges, diminishing the natural secretions, and is capable by various combinations of filling a variety of indications in disease. One of the chief uses of this salt is as an ingredient in preparations

for the hair which are designed to produce a gradual change of color, while by its astringency, it promotes the healthy and increased growth of the hair. The too free use of these applications is believed to have produced serious cephalic diseases. Dose, gr. ss to iij in pill, care being taken not to induce its poisonous effects. Externally, it is used in solution from gr. j to gr. viij to f℥j as a sedative, astringent, and desiccant to inflamed parts.

Liquor Plumbi Subacetatis, U. S. P. $Pb_2O\overline{Ac}$ in Aq = 491. (*Solution of Diacetate of Lead. Goulard's Extract. Strong Lead Water.*)

		Reduced.
Take of Acetate of lead	℥vxj	℥ij.
Semivitrified oxide of lead, in fine powder	℥ixss	℥ixss.
Distilled water	Oiv	Oss.

Boil them together in a glass or porcelain vessel for half an hour, occasionally adding distilled water so as to preserve the measure, and filter through paper; keep the solution in closely-stopped bottles. By the action of litharge on acetate of lead, an additional equivalent of the oxide enters into the composition of the salt, forming diacetate which remains in solution, while a basic acetate is separated on the filter.

This is one of the simple preparations, readily prepared, even by the country practitioner. The litharge should be in very fine powder before commencing the process, and care should be taken, by constant stirring, to prevent its caking, and the consequent fracture of the vessel; an evaporating dish will be found convenient, and in filtering, a covered funnel will be useful; the filter should be strengthened by a small filter set into the funnel at its narrowest part, in which the plaited filter may rest.

Solution of subacetate of lead is a clear colorless liquid, sp. gr. 1.267, with an alkaline reaction, and sweet, metallic astringent taste; agrees with the acetate in most of its properties, except that it precipitates arabin and numerous coloring matters and organic principles not precipitated by $Pb_2\overline{Ac}$. It is remarkable for its great affinity for carbonic acid, which occasions a precipitate of carbonate of lead, merely on exposure to the air. If this solution should be contaminated with copper, this metal will be removed by immersing a strip of bright metallic lead in it.

Diluted with water, it is applied as a sedative lotion to sprains, bruises, etc. (*See* Ceratum, and Linimentum Plumbi Subacetatis.)

Liquor Plumbi Subacetatis Dilutus, U. S. P. (*Lead Water.*)

Take of Solution of subacetate of lead	f℥iij.
Distilled water	Oj.

Mix them.

The water, containing carbonic acid, will produce a precipitate of carbonate of lead, which exposure to the air will increase, so that the preparation is liable to become inert, and should be mixed when required. Lead-water is generally regarded as a very weak preparation, and but for its popular employment as a cooling wash,

might be made much stronger, as may be readily done by extemporaneous prescription. The proportion indicated in the last edition of the *Pharmacopœia* is f℥iij to Oj; previously it had been f℥ij to Oj.

Lead-water should be made with *distilled* water as directed, common water frequently containing carbonates or carbonic acid, which impart a cloudiness as above mentioned; the habit of rendering the solution clear by means of acetic acid is improper, as the chemical character of the solution is changed.

Plumbi Carbonas. $2(PbCO_3) + Pb2HO = 775$. (*White Lead.*)

This important substance, which, as ground in oil, is extensively used as a pigment, is obtained by two methods: 1. By passing a stream of CO_2 through a solution of subacetate of lead. The CO_3 combines with the excess of Pb, and precipitates as Pb,CO_3, while a neutral acetate of lead remains in solution; this is boiled with a fresh addition of PbO, and again brought to the condition of subacetate, and treated as before with CO_2. This plan is pursued by the French and Swiss manufacturers. 2. Our own manufacturers cast the lead into thin sheets, which are then rolled into cylinders, five or six inches in diameter, and seven or eight high; each cylinder is placed in an earthen pot, containing Oss vinegar, the lead being supported by projecting pieces from contact with the vinegar. Strata of these pots are arranged in sheds, with refuse stable materials, which are giving off CO_2, and have a certain elevation of temperature due to fermentation. At the end of six weeks, the stacks are unpacked, and the sheet lead is found almost entirely converted into a flaky, white, friable substance, which is the white lead. This is separated, and reduced to fine powder. Carbonate of lead is a heavy, opaque substance, in powder or friable lumps, insoluble in water, of a fine white color, great opacity, inodorous, and nearly insipid. The analyses of Mulder and others, of different specimens of white lead, show that it contains various proportions of carbonate, $PbCO_3$, and hydrated oxide, Pb2HO, so that its combining proportion is not uniformly as above.

Carbonate of lead, to furnish a cheaper paint, is often mixed with sulphate of barium, calcium, or lead, or with carbonate of calcium (chalk); the last impurity will remain behind when the article is dissolved in caustic potassa; the former are all insoluble in diluted nitric acid, which readily dissolves the carbonate of lead.

This is regarded as the most poisonous of the lead salts; it is employed externally as a dusting powder in excoriations of children, and as an astringent and sedative dressing to ulcers and inflamed surfaces. (*See* Unguentum Plumbi Carbonatis.)

Plumbi Nitras. $Pb2NO_3 = 331$. (*Nitrate of Lead.*)

Litharge is dissolved in nitric acid, by the aid of heat; the liquid filtered, and set aside to crystallize; the Pb unites directly with the NO_4 to form the nitrate, which is an anhydrous salt, in beauti-

ful white, nearly opaque, octohedral crystals, permanent in the air, of a sweet astringent taste, soluble in water and alcohol.

It is an effectual disinfectant, decomposing sulphuretted hydrogen, and the hydrosulphurets contained in putrescent animal fluids.

Ledoyen's Disinfecting Fluid, which is greatly esteemed abroad, is a solution of this salt in water ʒj to fʒj. It may be made directly by dissolving carbonate of lead, or litharge, in diluted nitric acid, to saturation, and will be found extremely useful in sick chambers, where the alvine discharges are fetid and infectious.

Plumbi Nitras Fusa.—If nitrate of lead is fused at a temperature not high enough to decompose much of it, it may be moulded like lunar caustic, and applied in a similar manner.

Plumbi Iodidum. $PbI_2 = 461$. (*Iodide of Lead.*)

Take of Nitrate of lead,
Iodide of potassium, each, four troyounces.
Distilled water, a sufficient quantity.

With the aid of heat, dissolve the nitrate of lead in Oiss, and the iodide of potassium in Oss of the distilled water, and mix the solutions. Allow the precipitate formed to subside, and having poured off the supernatant liquid, wash it with distilled water, and dry it with a gentle heat. (*U. S. P.*)

This process may be readily accomplished with the apparatus usually pertaining to a country practitioner's outfit; in fact, it is one of the easiest processes of the *Pharmacopœia*. The two salts, dissolved separately, may be mixed in a wide-mouth bottle, and the precipitate collected in a plain filter.

Iodide of lead is a bright yellow, heavy, tasteless, inodorous powder, which dissolves in 1235 parts of cold and 194 parts of boiling water, and in acetic acid and alcohol. A hot saturated solution on cooling deposits the salt in brilliant golden scales. It fuses and sublimes yellow, but soon gives off violet vapors from decomposition. It may be considered pure for medicinal use if two grains of it dissolve in one fluidounce of boiling water, and separate on cooling in brilliant crystalline powder.

This preparation is supposed to have the resolvent properties of iodine, combined with those peculiar to lead, and hence it is used in ointment to reduce indolent tumors, scrofulous and syphilitic.

Plumbi Chloridum. $PbCl_2 = 278$.

Chloride of lead is obtained by precipitating a soluble lead salt, and may be crystallized from its hot solution in anhydrous flat needles, soluble in 135 parts of cold water.

It has been recommended as preferable to chloride of zinc in some diseases, especially cancer; externally as fomentations by dissolving from one-half to one drachm in a quart of water, and in ointments containing about ϑj or ʒss to the ounce.

Plumbi Tannas. (*Tannate of Lead.*)

Under the name of *cataplasma ad decubitum*, the *Prussian Pharmacopœia* prepares tannate of lead in the following manner: 2 oz. oak bark, boiled with a sufficient quantity of water down to eight ounces, is mixed with two ounces of solution of subacetate of lead, the precipitate separated by filtration, and used while still moist, mixed with two drachms of alcohol.

The tannate of lead is also prepared by precipitating tannic acid or an infusion of galls by acetate of lead. The precipitate is much darkened during washing and drying; it is made into an ointment by mixing one drachm of it with an ounce of lard or other unctuous ingredient.

Argentum. Ag = 108. (Silver.)

This well-known metal is placed in the list of the *Pharmacopœia* on account of its use in preparing the several salts. It is found most abundantly as sulphuret combined with copper, lead, and antimony; the argentiferous galena, already referred to as furnishing litharge, is the most abundant source of silver.

Its physical properties are sufficiently familiar. It is very malleable and ductile; its hardness is between that of copper and gold; sp. gr. 10.475 to 10.500.

Silver is freely soluble in nitric acid, and dissolves in sulphuric acid by the aid of heat. Its surface is rapidly tarnished by sulphuretted hydrogen. Its nitric acid solution should be nearly colorless, and when treated with an excess of chloride of sodium, should give a white precipitate entirely soluble in ammonia, the liquor filtered from the precipitate with excess of HCl should not be discolored by sulphuretted hydrogen. The alkaline carbonates, oxalates, and ferrocyanides precipitate solutions of silver white, the alkaline arsenites and phosphates yellow. The arseniates red—the fixed alkalies brown—on the surface of metallic copper or zinc it is thrown down as pure silver. All silver salts are more or less blackened by the influence of light, hence their use in photography.

Preparations of Silver.

Argenti nitras, $AgNO_3$ (crystals). Colorless; soluble in water; staining the skin.
Argenti nitras fusa. In sticks thickness of a quill; usually wrapped in paper.
Argenti oxidum. Ag_2O. An olive-brown insoluble powder; soluble in ammonia.
Argenti cyanidum, AgCy. A white, odorless, tasteless, insoluble powder.
Argenti chloridum, AgCl. White, curdy precipitate, changing color.
Argenti iodidum, AgI. Pale yellow, less soluble in ammonia.

Argenti Nitras. $AgNO_3 = 170$. (*Crystallized Nitrate of Silver.*)

This salt is made by dissolving silver in nitric acid, evaporating the solution, and crystallizing. The crystals are anhydrous and colorless. Its purity is proven by precipitating its solution in distilled water with muriatic acid; the filtrate on evaporation must leave no residue. It is soluble in its weight of water, stains the

skin black, and, when moistened and applied, acts as a caustic, which is its chief use. The crystallized article is preferred for solution, being less liable to be adulterated, and to decompose by the action of light, than the fused and wrapped article. Internally it is given in pill with a tonic extract, preferably extract of quassia, as an astringent and alterative affecting the nervous system. When administered a long time it is liable to stain the whole surface of the body blue or lead color. DOSE, gr. $\frac{1}{4}$ to gr. j.

Argenti Nitras Fusa. $AgNO_3 = 170$. (*Lunar Caustic.*)

This is made as the preceding, except that, instead of crystallizing it, the evaporation is carried further, and after becoming dry it is fused, and when it runs like oil is poured into moulds. It is thus obtained in sticks of suitable sizes for application as a caustic; it is, however, crystalline in structure, and very brittle. When the sticks have cooled, they are wrapped tightly in paper, in which they are sold. The crystals are more economical to the purchaser from having less paper weighed with them. The heat applied in the fusion, and the contact with organic matter, reduce a portion to the metallic condition, so that it has a gray color, and is not entirely soluble. The fusible nature of this salt enables us to introduce it readily into silver catheters and other surgical instruments, and also, by a very ready expedient, to point the sticks and alter them in size, thus:—

Heat a half dollar held in a pair of pincers over a lamp, and apply to it the end of the stick of caustic, rotating it at such an angle as to give the requisite sharpness; if the coin is hot enough, the caustic will fuse at the point and take the shape desired.

The extensive use of the nitrate and its high price lead to the admixture of nitrate of potassium, especially with the fused article; this adulteration may be detected as described in the case of the crystallized article, or by passing a stream of sulphuretted hydrogen into its solution till it ceases to throw down sulphuret of silver, then filtering and evaporating; there should be no residue. If 17 grains of the nitrate are dissolved in water, it should precipitate entirely the chlorine of 6 grains of common salt. The following is an elegant method of testing approximately the amount of silver in a specimen of nitrate of silver:—

Into a good velvet bottle cork insert a handle, which may be of wire, and in the opposite end cut a small cavity sufficient to hold 15 grains of the nitrate, which is to be weighed and pressed securely in; now apply a spirit-lamp flame, which will ignite the end of the cork and melt the nitrate. The fused nitrate, by contact with the heated carbon, will be reduced, suddenly bursting into an intense flame of a peach-blossom hue. On the subsidence of the flame there will be found a mass of spongy silver, which, when washed and dried, should weigh about 9.5 grains, thus: $AgNO_3 = 170$ and $Ag = 108$. As 170 : 108 : : 15 : 9.53.

Chloride of silver is much introduced of latter years for the pur-

pose of rendering the fused nitrate less brittle. This admixture should always be distinctly announced on the label. It renders the salt only partially soluble in water, and opaque white instead of translucent.

The stain of nitrate of silver on the fingers and on articles of clothing is sometimes very inconvenient; it may generally be removed by a little cyanide of potassium, or by moistening the part with tincture of iodine and immediately applying ammonia, and then washing it off.

So numerous are the incompatibles of nitrate of silver that it should generally be prescribed in pill, and singly except with some vegetable excipient, as white turpentine. It generally forms a white cloud, with the purest undistilled water, from the presence of chlorides, and in water containing organic matter after a time throws down a brown precipitate.

Argenti Chloridum. AgCl=143.5.

When a silver salt is brought in contact with muriatic acid, or a solution of a chloride, the result is always a white curdy precipitate of chloride of silver, which is insoluble in nitric acid, but dissolves freely, without residue, in ammonia.

It has been used in syphilis, epilepsy, dysentery, and other diseases, in doses from one to three grains several times a day.

Argenti Iodidum. AgI=235.

It is a pale yellow precipitate, caused in solution of silver by hydriodic acid or iodides; insoluble in nitric acid, and nearly insoluble in ammonia.

It has been used in similar complaints to those in which the chloride is prescribed, when the modified effect of an iodide is desired. The dose is one or two grains.

Argenti Oxidum. Ag_2O=232. (*Protoxide of Silver.*)

Take of Nitrate of silver, four troyounces.
Distilled water, half a pint.
Solution of potassa, a pint and a half, or sufficient.

Dissolve the nitrate of silver in the water, and add the solution of potassa as long as it produces a precipitate; wash this repeatedly with water, until the washings are nearly tasteless. Lastly, dry the precipitate, and keep it in a well-stopped bottle, protected from the light. (*U. S. P.*)

This is an olive-brown powder, nearly insoluble in water, but soluble in ammonia and in acids. It may be considered pure if it is wholly soluble in ammonia and in nitric acid, and if the latter solution, when treated like the nitrate, leaves no residue, and if on being precipitated by chloride of sodium in excess, the supernatant liquid is not discolored by H_2S.

It is used instead of nitrate of silver for the tonic effects of the silver salts. Dose, gr. ss to gr. ij.

Argenti Cyanidum. AgCy = 134. (*Cyanide of Silver.*)

The salt is elsewhere described in connection with its use in preparing hydrocyanic acid. It is a tasteless, white powder, insoluble in water, soluble in ammonia and in cyanide of potassium; and when decomposed by muriatic acid, the solution must not contain any fixed matter. When heated, it yields cyanogen and metallic silver.

BISMUTHUM. Bi = 210. (BISMUTH.)

This is a metal, of a pinkish-white color, found native; very brittle; fuses readily, and crystallizes; soluble in diluted nitric acid, and the nitrate is precipitated by water. It is chiefly prepared in Germany, whence it is exported; it generally contains both arsenic and copper, to free it from which the following dry process is recommended. Heat to redness, in a covered crucible, a mixture of oxide or subnitrate of bismuth, with half its weight of charcoal, or mix sixteen ounces of the metal, powdered, with two ounces of carbonate of sodium, and two drachms of sulphur; mix, fuse for an hour, and separate the metal from the scoriæ.

Bismuth is used in the composition of type metal, solder, pewter, and fusible metals. The following proportions yield useful alloys, adapted to baths, and to taking impressions of plaster casts, etc. The alloy of 8 parts bismuth, 5 lead, 3 tin, melts at 202° F. That composed of 2 bismuth, 1 lead, 1 tin, melts at 200.75° F.

It is little affected by the air; burns when strongly heated; sp. gr. 9.8 to 9.9. Sulphuretted hydrogen gives a black precipitate with its salts; the nitric solution is not precipitated by sulphuric acid. Chromate of potassium gives a yellow precipitate, differing from that of lead by being soluble in NO_3, and insoluble in KO. By alkalies a white precipitate is thrown down, insoluble in an excess; by carbonate of potassium, white; by ferrocyanuret of potassium, white; by iodide of potassium, brown; by iron, zinc, copper, cadmium, tin, and lead, in the metallic state. The soluble salts of bismuth are remarkable for a dazzling white precipitate, produced on throwing their solution into a large amount of water.

PREPARATIONS OF BISMUTH.

Bismuthi subnitras, $BiONO_3.H_2O$. Insoluble powder.	DOSE, gr. v to ʒj.
Bismuthi subcarbonas, $Bi_2O_2CO_3$. Insoluble powder.	DOSE, gr. v to ʒss.
Bismuthi valerianas. Remedy in neuralgia.	DOSE, gr. ss to gr. ij.
Bismuthi tannas, $Bi,\overline{Tan}$. Insoluble powder.	DOSE, ʒss.
Liquor bismuthi et ammoniæ citratis, Ph. Br.	

Bismuthi Subnitras. $BiONO_3 + Aq = 306$.

Take of Bismuth, in pieces, two troyounces.
Nitric acid,
Carbonate of sodium, each, ten troyounces.
Water of ammonia, six fluidounces.
Distilled water, a sufficient quantity.

Mix four troyounces and a half of the nitric acid with four fluidounces of distilled water, in a capacious glass vessel, and, having

added the bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with ten fluidounces of distilled water, stir it thoroughly, and, at the end of twenty-four hours, filter through paper.

Dissolve the carbonate of sodium in twenty fluidounces of distilled water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless, and drain again as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the nitric acid and afterwards four fluidounces of distilled water, and set the solution aside. At the end of twenty-four hours, filter through paper, and to the filtered liquid, previously diluted with four pints of distilled water, slowly add the water of ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with two pints of distilled water, drain it again. Lastly, dry it upon bibulous paper with a gentle heat, and rub it into powder.

The simple formula formerly adopted for this preparation has been so greatly modified in the present officinal directions, that it is deemed proper to introduce them, as above, in detail. The addition of diluted nitric acid to bismuth results in the oxidation of the metal at the expense of the acid, giving off red fumes; the oxide formed dissolves in the remainder of the acid; this is a solution of ternitrate of oxide ($Bi,3NO_3$). Formerly the preparation was finished by throwing this into water, by which four equivalents were resolved into three of basic, generally called subnitrate (BiO_3NO_3), and one of the "nine nitrate," $BiO_3 9NO_3$, the latter remaining in solution, while the officinal salt went down as a heavy, white, insoluble powder. The modified process now inserted in the *Pharmacopœia* directs the precipitation of the solution of the ternitrate with carbonate of sodium, by double decomposition, yielding nitrate of sodium in solution and insoluble subcarbonate of bismuth, which, by washing, is obtained pure; and is then dissolved in a fresh portion of nitric acid; in this way, the arsenic which may have been contained in the first solution is separated in a soluble form by the addition of the carbonated alkali and the subsequent washing. The solutions are directed to be diluted till precipitation commences, and exposed for twenty-four hours, by which the remaining arseniate of bismuth, which is rather insoluble in dilute acid solutions, is separated; the precipitate is then removed by filtration, and the subnitrate obtained by the addition of distilled water, and then ammonia. This last named addition increases the precipitate by neutralizing any excess of nitric acid, which otherwise holds in solution much of the bismuth.

Subnitrate of bismuth is a heavy, white powder, of a somewhat satiny appearance. It has a faintly acid odor and taste, and, when moistened on litmus paper, a decidedly acid reaction. It is entirely

soluble, without effervescence, in nitric acid, and the solution yields no precipitate with dilute sulphuric acid. Upon being heated to redness it loses twenty per cent. of its weight. When mixed with dilute sulphuric acid in excess, and subjected to Marsh's test, it yields no arsenic, or merely a trace.

Subnitrate of bismuth is a sedative and antispasmodic of very useful and peculiar properties; its chief use is in gastro-intestinal affections, diarrhœa, and nausea. The dose is one to six or ten grains. It is also employed as a cosmetic, from its white and satiny appearance. The presence of arsenic, in the commercial varieties and in specimens prepared by the old process, is believed by some physicians to have a bearing upon its therapeutic properties, and perhaps to add to its efficiency.

Bismuthi Subcarbonas. $Bi_2O_2CO_3 = 512$.

Take of Bismuth, in pieces, two troyounces.
Nitric acid, eight troyounces and a half.
Water of ammonia, five fluidounces.
Carbonate of sodium, ten troyounces.
Distilled water, a sufficient quantity.

Mix four troyounces and a half of the nitric acid with four fluidounces of distilled water in a capacious glass vessel, and, having added the bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with ten fluidounces of distilled water, stir it thoroughly, and, after twenty-four hours, filter through paper. To the filtered liquid, previously diluted with four pints of distilled water, slowly add the water of ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with two pints of distilled water and drain it again. Then place the precipitate in a proper vessel, add the remainder of the nitric acid, and afterwards four fluidounces of distilled water, and set the solution aside. At the end of twenty-four hours, filter through paper.

Dissolve the carbonate of sodium in twenty fluidounces of distilled water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with distilled water until the washings pass tasteless. Lastly, dry it on bibulous paper with a gentle heat, and rub it into powder. (*U. S. P.*)

The elaborate process of the *Pharmacopœia* for this new remedy has been transferred entire as above, so as to furnish the pharmacist, who is disposed to follow it through its several steps, a pure preparation. It will be seen that the first part of the process is nearly that formerly used for the preparation of subnitrate of bismuth with the addition of ammonia in the first precipitation; this is a useful addition as aiding the more complete separation of the subnitrate. A solution of this freshly precipitated subnitrate, in additional nitric acid, by the aid of heat, is the next step in the process; this solution of nitrate is now diluted till it begins to be

milky, and then set aside for twenty-four hours (still longer is to be preferred) in order that any arsenic present may be precipitated as arseniate of bismuth; it is now filtered and gradually added to a solution of carbonate of sodium, which, by double decomposition, yields nitrate of sodium which remains in solution, and subcarbonate of bismuth which precipitates as a white insoluble powder; by washing and drying, this is obtained ready for use.

Subcarbonate of bismuth is a white or yellowish-white powder, without taste or smell, insoluble in water, but soluble with effervescence in dilute nitric acid. Upon being heated to redness, it loses nine and a half per cent. of its weight. When mixed with dilute sulphuric acid in excess, and subjected to Marsh's test, it yields no arsenic or merely a trace.

The carbonate is a new officinal preparation originally introduced as a purer and more uniform salt than the subnitrate, more soluble in the juices of the stomach, and adding to the peculiar sedative and absorbent properties of that salt a decided antacid property. The dose is from five to thirty grains, given in powder or pill.

Bismuthi Valerianas.

Prepared by adding gradually an aqueous solution of ternitrate of bismuth ($BiNO_3$), prepared as in the process for subnitrate or carbonate, to valeriante of sodium; the white precipitate is washed with water containing a small quantity of valerianic acid, and dried by a very gentle heat.

It has been brought to the notice of the medical profession as a remedy for neuralgic affections, in doses of from one-half to two grains three or four times a day.

Bismuthi Tannas.

Tannate of bismuth is prepared by first precipitating the oxide of bismuth from a solution of 44 parts of the crystallized nitrate by an excess of caustic soda, this precipitate is collected on a cloth and carefully washed, it is then triturated in a mortar with 29 parts of pure tannic acid. The magma is then diluted with water, the whole is thrown on a cloth, washed, and then dried either in the open air or in a slightly heated closet.

This is a yellowish, insoluble, nearly tasteless powder, which has been introduced as a remedy for obstinate diarrhœa. The dose mentioned in the journals is 30 grains.

Liquor Bismuthi et Ammonii Citratis. Ph. Br. (*Solution of Citrate of Bismuth and Ammonia.*)

Take of Purified bismuth, four hundred and thirty grains.
Nitric acid, two fluidounces (imperial measure).
Citric acid, two ounces (avoirdupois).
Solution of ammonia,
Distilled water, of each, a sufficient quantity.

Mix the nitric acid with a sufficient quantity of distilled water, and add the bismuth in successive portions. When effervescence

has ceased, apply, for ten minutes, a heat approaching that of ebullition, and decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to two fluidounces; then add the citric acid previously dissolved in four fluidounces of distilled water, and afterwards the solution of ammonia in small quantities at a time, until the precipitate formed is redissolved and the solution is neutral or slightly alkaline to test paper. Dilute with distilled water to the volume of one pint (imperial measure).

This is a new officinal preparation in the Ph. Br. made after the plan of Mr. Tichborne. For various hints on the process, the reader is referred to *American Journal of Pharmacy*, January 1865, January 1866.

CHAPTER IX.

ANTIMONY AND ARSENIC PREPARATIONS.

Antimony. Sb=122.*

This metal, which was one of the first introduced into medicine, is imported from France under the name of *Regulus of Antimony;* it is a brittle metal, usually of a lamellated texture, of a bluish-white color; its Latin name, *Stibium*, as abbreviated Sb, furnishes its symbol. It forms three combinations with oxygen, teroxide, Sb_2O_3, antimonious acid, Sb_2O_4, and antimonic acid, Sb_2O_5. Teroxide and the tersulphuret enter into the officinal compounds.

Tests for Antimony.—In its soluble salts, *antimony* is recognized by the following tests:—

Sulphuretted hydrogen and sulphuret of ammonium cause in acid solutions an orange-colored precipitate; alkalies and their carbonates, a white, bulky one; zinc, a black powder of the metallic antimony; zinc and sulphuric acid evolve antimoniuretted hydrogen, SbH_3, which burns with a bluish-green color; on a porcelain cup, held in the flame, a black spot of very little lustre is deposited; if the antimoniuretted hydrogen is passed through a tube, the middle of which is heated to redness, a bright metallic mirror is formed in the cooler part of the tube; this mirror will disappear if a stream of dry sulphuretted hydrogen is passed through the tube, while the metallic mirror is heated, and sulphuret of antimony of a reddish or blackish color will make its appearance; this disappears entirely if through the tube be passed a stream of dry muriatic acid gas, by which chloride of antimony is carried over and may be condensed in water, there to be recognized by the precipitates with the above tests. Before the blowpipe, oxide of antimony, when

* The combining number formerly given for this metal, 129, has been reduced by recent authorities.

mixed with carbonate of sodium and cyanide of potassium, yields globules, and a white pulverulent and crystalline incrustation of the oxide.

Antimonic Acid.—Its salts are insoluble with the exception of antimonate of potassium, which is a test for sodium salts. This antimoniate may be recognized by yielding precipitates with the soluble salts of all other bases; these precipitates, when mixed with chloride of ammonium and heated, are decomposed into water, chloride of antimony, chloride of the metallic base and ammonia; the chloride of antimony is volatile. For the quantitative determination of antimonic acid, H. Rose uses the antimoniate of sodium, and calculates from the remaining chloride of sodium the equivalent quantity of antimonic acid. If insoluble antimoniates are boiled with muriatic acid, with the addition of some tartaric acid, terchloride of antimony enters into solution, there to be recognized like the salts of oxide of antimony.

Preparations of Antimony.

Antimonii sulphuretum, Sb_2S_3. Native black sulphuret, or crude antimony.
Antimonii sulphuratum, $Sb_2S_3 + Sb_2O_3$. Reddish-brown powder.
Antimonii oxysulphuretum, $Sb_2O_3 + 2Sb_2O_3$. Dark-brown powder. Kermes mineral.
Sodii et antimonii sulphuretum, $3Na_2S + Sb_2S_5$. Colorless crystals.
Antimonii quinque sulphuretum, Sb_2S_5. Orange-colored powder. Golden sulphur.
Calcii et antimonii sulphuretum, $Sb_2O_3.Sb_2S_3.CaS$. Light-brown powder.
Antimonii chloridum, $SbCl_3$. Colorless or yellowish liquid (butter of antimony).
Antimonii oxidum, Sb_2O_3. Antimonic oxide, antimonious acid. White, inodorous powder.
Potassii antimonias, $K_2Sb_4O_{11} + H_2O$. White, insoluble powder.
Antimonii et potasii tartras, $2KSbT + 3H_2O$. Translucent crystals.
Vinum antimonii. Gr. ij to f℥j white wine = ¼ gr. to f℥j.
Pulvis antimonialis. Variable mixture of $Sb_2O_3Sb_2O_5$ with $Ca_3 2PO_4$.

Antimonii Sulphuretum. $Sb_2S_3 = 340$. (*Black Sulphuret of Antimony.*)

This drug should be procured in powder somewhat purified by fusion and levigated, in which condition it is kept by the druggists; it may then be considered as tolerably pure Sb_2S_3.

It should be soluble in boiling muriatic acid, giving off sulphuretted hydrogen, terchloride remaining in solution. The solution yields a white precipitate when added to water, and the resulting liquid, after filtration, affords an orange-red precipitate with sulphuret of ammonium.

It often contains arsenic, which may be found out by fusing it in small quantities with pure saltpetre, and testing the solution with nitrate of silver; antimoniate of silver is white, the arseniate has a reddish-brown color.

Antimonii Sulphuratum, U. S. P. $Sb_2S_3 + Sb_2O_3 + 16Aq$. *Antimonii Sulphuretum Præcipitatum*, U. S. P. of 1850. (*Precipitated Sulphuret of Antimony. Sulphurated Antimony.*)

This officinal salt is made by boiling black sulphuret of antimony, six troyounces, with solution of potassa, four pints, diluted

with twelve pints of water, straining it, and, while yet hot, dropping into it diluted sulphuric acid as long as it produces a precipitate, which, being washed with hot water and dried, and rubbed into a fine powder, constitutes the officinal precipitated sulphuret.

In this process, the alkali decomposes a portion of the black sulphuret, forming sulphuret of potassium, and holds in solution both the undecomposed tersulphuret and the teroxide liberated by the alkali. On the addition to this of an acid, the sulphuret of potassium being decomposed, and the excess of potassa neutralized, the mixed tersulphuret and teroxide are thrown down, so that this powder has the complex composition represented in the syllabus. According to Liebig it is amorphous hydrated tersulphuret of antimony, which loses part of its water by drying, the other part is only given off by exposure to a temperature of 480°.

This powder is of a color varying from brownish-red to reddish-brown, insoluble in water, but nearly soluble in solution of potassa, and in twelve times its weight of muriatic acid, by the aid of heat; this solution, when added to water, deposits a white powder.

It is used as an alterative and diaphoretic, especially in combination with calomel and guaiacum, as in Plummer's pills, or with extract of conium or hyoscyamus in the treatment of chronic rheumatism. As its action depends very much upon the amount of acid in the stomach, it is of varying activity. Its dose is from gr. j to iij, twice a day.

Antimonii Oxysulphuretum, U. S. P. (*Oxysulphuret of Antimony. Kermes Mineral.* $Sb_2O_3 + 2Sb_2S_5$.)

The various processes heretofore published for this preparation are now superseded by the introduction into the *U. S. Pharmacopœia* of 1860 of the following formula:—

Take of Sulphuret of antimony, in very fine powder, a troyounce.
Carbonate of sodium, twenty-three troyounces.
Water, sixteen pints.

Dissolve the carbonate of sodium in the water previously heated to the boiling point, and, having added the sulphuret of antimony, boil for an hour. Then filter rapidly into a warm earthen vessel, cover this closely, and allow the liquid to cool slowly. At the end of twenty-four hours, decant the supernatant liquid, drain the precipitate on a filter, wash it with boiled water previously allowed to become cold, and dry it without heat. Lastly, preserve the powder in a well-stopped bottle, protected from the light. (*U. S. P.*)

By the long boiling of the native sulphuret of antimony with carbonate of sodium, the sulphuret is partially decomposed, forming, as in the foregoing process, sulphuret of potassium and teroxide of antimony; after filtering to separate the undecomposed sulphuret of antimony, the solution is allowed to cool slowly and then precipitates the kermes, which has a tolerably uniform composition, containing, as stated above, a much larger proportion of the teroxide than the sulphurated antimony which is precipitated by the aid of an acid.

Oxysulphuret of antimony is a purplish-brown, tasteless powder, soft and velvety to the touch, wholly and readily soluble in muriatic acid with evolution of hydrosulphuric acid gas, and partly soluble in a hot solution of potassa, leaving a residue soluble in tartaric acid.

The dose, in view of this various composition, may be stated at from gr. $\frac{1}{2}$ to gr. iij. It is a more active preparation than the foregoing.

Sodii et Antimonii Sulphuretum. $3Na_2S+Sb_2S_5+18Aq.$ (*Antimonio-Sulphuret of Sodium.*)

This double salt, which is officinal in the *Pharmacopœias* of Slesvie-Holstein, Saxony, and others, is remarkable for its readiness to crystallize with an unvariable composition, and for its use in the preparation of golden sulphur. It was discovered by Schlippe.

It is prepared by slaking 2 parts of burned lime in an iron vessel, and dissolving in it 2 parts of sulphur by boiling with 40 parts of water; the clear liquid is decomposed by 6 parts of crystallized carbonate of sodium; the filtrate boiled with 2 parts of finely-powdered black sulphuret of antimony, evaporated, a little caustic soda added, and crystallized.

Another method is to fuse for half an hour a mixture of equal parts of anhydrous sulphate of sodium, sulphuret of antimony, and a quarter part of charcoal, and, after separating the metal and powdering the mass, boiling it in water and crystallizing as above.

It occurs in colorless or yellowish tetrahedrons, easily soluble in water, insoluble in alcohol, and decomposed by acids, alkalies, and metallic salts. It contains 45.29 per cent. of Sb_2S_5.

Golden Sulphuret of Antimony. $Sb_2S_5=404.$ (*Golden Sulphur. Quinque Sulphuret of Antimony.*)

Antimonii sulphuretum aureum, as formerly prepared, was deposited on the addition to the solution from which kermes has been precipitated, of an acid; it thus varied in composition and in color according to the degree of change which has taken place spontaneously, and the consequent proportion of sulphur thrown down with the antimonial sulphuret and oxide.

As now prepared, it is of a uniform composition, being the *quinque sulphuret of antimony*, which contains 61.8 per cent. metallic antimony. The sulphuret of antimony and sodium, as above, is dissolved in 6 parts of distilled water, and the solution gradually added to a mixture of $\frac{1}{10}$ strong sulphuric acid and 10 of water; the precipitate is well washed and rapidly dried.

It is a dark orange-colored powder, nearly tasteless and inodorous, insoluble in water and alcohol; by alkalies it is decomposed, an antimonio-sulphuret being dissolved and antimoniate of alkali left behind; it is soluble without residue in sulphuret of ammonium. The quinque sulphuret of antimony is given in doses of $\frac{1}{4}$ to 1 grain.

Calcii et Antimonii Sulphuretum. Mixed Sb_2O_3,Sb_2S_3,CaS.

This soluble sulphuret, as used by Hufeland, was an uncertain preparation, containing sulphuret of antimony and calcium, sulphate and antimoniate of calcium. It was prepared by exposing to a red heat a mixture of carbonate of calcium, sulphur, and sulphuret of, or metallic, antimony.

No double sulphuret with calcium has yet been obtained resembling the foregoing antimonio-sulphuret of sodium. Duflos proposes to mix intimately 1 part of Liebig's kermes with 4 parts of sulphuret of calcium, by which process a brownish powder is obtained, almost entirely soluble in water, and decomposed by acids into sulphuretted hydrogen, and a bright red sulphuret of antimony.

It is a mixture of the two sulphurets with oxide of antimony, and has no claims to the rank of a chemical compound. It has been used in various skin diseases, etc., in larger doses than the other antimonials.

Antimonii Chloridum. $SbCl_3 = 228.5$. (*Butter of Antimony.*)

In accordance with the Prussian *Pharmacopœia*, this preparation is made by dissolving 1 lb. of black sulphuret of antimony in 4 lbs. of crude muriatic acid. These proportions are nearly those of our *Pharmacopœia*, in the preliminary process for oxide of antimony. Sulphuretted hydrogen is evolved, which makes it necessary to operate in the open air, or conduct the gas into water or a chimney. After filtration, it is evaporated to $1\frac{1}{2}$ lb., and a mixture of $\frac{3}{4}$ lb. muriatic acid, and $1\frac{1}{2}$ lb. water, is added.

It is a colorless or yellowish liquid, sp. gr. 1.4, free from arsenic and lead, and is decomposed by water, oxide of antimony with some chloride being precipitated; this precipitate was formerly employed in medicine under the name of *Pulvis Algerothi.*

Chloride of antimony has been used as a caustic, producing a white scab with little pain; it may be made into ointments containing one drachm to the ounce, or if intended for diseases of the eye, from 10 to 15 grains to an ounce.

Antimonii Oxidum. $Sb_2O_3 = 292$. (*Oxide of Antimony. Teroxide of Antimony. Antimonic Oxide. Antimonious Acid.*)

Take of Sulphuret of antimony, in very fine powder, four troyounces.
Muriatic acid, eighteen troyounces.
Nitric acid, a troyounce and one hundred and twenty grains.
Water of ammonia, a fluidounce and a half.
Water,
Distilled water, each, a sufficient quantity.

Introduce the sulphuret into a flask, of the capacity of two pints, and, having added the muriatic acid, digest, by means of a sand-bath, until effervescence ceases. Then, having removed the flask from the sand-bath, add the nitric acid gradually; and, when nitrous acid vapors cease to be given off, and the liquid has grown cold, add to it half a pint of water, and filter. Pour the filtered

liquid gradually into twelve pints of water, constantly stirring, and allow the precipitate to subside. Decant the supernatant liquid, and wash the precipitate twice by decantation, using, each time, eight pints of water. Then transfer it to a muslin filter to drain, and, after the draining is completed, wash it with water until the washings cease to have an acid reaction. Next introduce it into a suitable vessel, and subject it to the action of the water of ammonia for two hours; at the end of which time, transfer it to a moistened muslin filter, and wash it with distilled water as long as the washings produce a precipitate with nitrate of silver. Lastly, dry the precipitate upon bibulous paper with the aid of a gentle heat. (*U. S. P.*)

This new officinal process is designed to furnish a pure oxide of antimony, for use in making tartar emetic, and for separate employment in medicine. The sulphuret being digested with muriatic acid forms chloride of antimony, with the liberation of hydrosulphuric acid gas, which should be conducted into a flue, or the process should be conducted in the open air. ($Sb_2S_3 + 6HCl = 2SbCl_3 + 3HS,3H$.) The addition of nitric acid aids the complete decomposition of the sulphuret, and oxidizes the iron to ferric oxide. By pouring the solution into a large quantity of water, it is decomposed, oxide of antimony contaminated with some undecomposed chloride being precipitated, while chloride of iron and other foreign chlorides remain in solution. This precipitate, formerly called oxychloride or powder of Algeroth, is directed to be washed and treated with water of ammonia, which decomposes any chloride, converting the whole into the teroxide, which is insoluble in excess of ammonia, and being collected, washed, and dried, is a permanent and uniform product.

Oxide of antimony is a grayish-white powder, insoluble in water, but readily and wholly soluble in muriatic and tartaric acids. It fuses at a dull red heat, forming a yellowish liquid, which concretes, on cooling, into a crystalline mass of a pearl-color. Its solution in tartaric acid in excess gives no precipitate with nitrate of silver or with ferrocyanide of potassium.

Oxide of antimony is adapted to supersede the more uncertain precipitated sulphuret and oxysulphuret, and probably will be found a good substitute for small doses of tartar emetic, as an alterative and sedative. The dose may vary from $\frac{1}{12}$th of a grain to one grain.

It is most frequently prescribed in the following:—

Tyson's Antimonial Powder, No. 1.

Take of Oxide of antimony	2 grains.
Phosphate of calcium	18 grains.

Mix well.

Tyson's Antimonial Powder, No. 2.

Take of Oxide of antimony	2 grains.
Phosphate of calcium, Sulphate of potassium, of each	9 grains.

Mix well.

These powders are used in doses of from 5 to 10 grains.

Potassii Antimonias. $K_2Sb_4O_{11} + Aq.$

Formerly preparations were employed in medicine under the name of *antimonium diaphoreticum non-ablutum* and *ablutum*, which were of variable composition. A preparation similar to the last named is officinal in the *Prussian Pharmacopœia*, which is nearly pure antimoniate of potassium. It is prepared by throwing into a red-hot crucible small quantities of an intimate mixture of 1 part metallic antimony and 2 parts nitrate of potassium, continuing the heat for half an hour, and washing with water.

It is a white, inodorous, and tasteless powder, which is a diaphoretic in doses of ½ to 1 grain.

Antimonii et Potassii Tartras. $2KSb\overline{T} + 3H_2O(?)$ *Antimonii Potassio Tartras.* (*Tartar Emetic.*)

This preparation, as its name implies, is a double salt, consisting of the oxide of antimony and potassium, united with tartaric acid. The first step in its preparation is the precipitation of teroxide of antimony, Sb_2O_3, by the new officinal process already detailed. Four parts of the oxide are then to be boiled with five of bitartrate of potassium in water till the combination is complete, and the solution after filtration is set aside to crystallize. The oxide unites with the tartaric acid of the bitartrate, forming a double tartrate of antimony and potassium, in the same way that iron is combined so as to form with the bitartrate the double tartrate of iron and potassium, etc. (*See, also*, Sodii et Potassii Tartras and Potassæ Tartras.) Cream of tartar being a bitartrate, the explanation as above given is correct.

Tartar emetic crystallizes in beautiful colorless, rhombic, octahedral crystals, which effloresce and become opaque by exposure to the air. It is wholly soluble in 20 parts (14 parts, Graham) of cold water. Its solution does not yield a precipitate with chloride of barium, or, if very dilute, with nitrate of silver. Hydrosulphuric acid gas causes an orange-red precipitate. The watery solution is remarkable for decomposing rapidly, forming algæ.

The *Pharmacopœia* gives this test: a solution containing one part in forty of water is not disturbed by an equal volume of a solution of eight parts of acetate of lead in thirty-two of water and fifteen of acetic acid.

If arsenic should be present, it may be discovered by fusing a sample of the tartar emetic with pure nitrate of potassium, and testing the neutralized solution with nitrate of silver, which by producing a reddish-brown precipitate, shows a contamination with arsenic.

It is insoluble in alcohol and incompatible with acids, alkalies, and alkaline carbonates. Astringent solutions precipitate the antimony in an insoluble form.

Internally administered, tartar emetic, in doses of gr. ij to iv, is a powerful emetic; in doses of gr. $\frac{1}{16}$ to ¼, it is a diaphoretic and expectorant; gr. ⅙ to gr. j, is a decided sedative. It is very much

prescribed, and in a great variety of diseases, both alone and combined with other remedies. Externally it is applied in ointment to raise a peculiar pustular eruption. (*See* Unguentum Antimonii.)

This salt is now largely used in the process of dyeing with aniline colors; combined with tannin it serves the purpose of fixing them upon cotton fabrics.

Vinum Antimonii, U. S. P. (*Antimonial Wine.*)

Take of Tartrate of antimony and potassium, thirty-two grains.
Boiling distilled water, a fluidounce.
Sherry wine, a sufficient quantity.

Dissolve the salt in the distilled water, and while the solution is hot add sufficient sherry wine to make it measure a pint.

Dose, as an expectorant diaphoretic, ℥x to xxx, at intervals; its chief use is to furnish a convenient method of giving very divided doses of the salt; f℥j contains ¼ grain.

Pulvis Antimonialis. (*Pulvis Jacobi. James's Powder.*)

This is directed to be made by mixing black sulphuret of antimony with horn shavings, throwing into a red-hot crucible, and stirring till vapor no longer rises, then rubbing the residue to powder and heating it to redness for two hours. Reduced to a fine powder, the resulting compound is constituted chiefly of a mixture in variable quantities of teroxide of antimony (Sb_2O_3), antimonic acid (Sb_2O_5), with phosphate of calcium. It is a white, inodorous, tasteless, insoluble powder, which was formerly much in use as an alterative and diaphoretic, and was officinal previous to 1830. *Tyson's antimonial powder*, No. 2 (p. 289), resembles James's powder in its properties, and may be substituted for it by physicians in their prescriptions. Its dose is gr. iij to gr. x, every three or four hours, in fevers.

Arsenicum = 75.

This metal, which is made officinal on account of its use in preparing its iodide, exists in nature in combination with nickel and cobalt. Owing to its volatile and oxidizable character, it is conveniently collected as arsenious acid, during the smelting of these ores. When pure, metallic arsenic is brittle and granular, steel-colored, but usually dull and blackish on the surface; density, 5 to 5.96. When heated, it sublimes, giving off a garlicky odor, and if exposed to the air in the condition of vapor, absorbing oxygen and passing into arsenious acid, AS_2O_3. It forms, by higher oxidation, arsenic acid, As_2O_5; and also combines readily with sulphur.

Pure metallic arsenic may be readily obtained by mixing, in a suitable reduction tube, arsenious acid with three parts of black flux or charcoal, and applying heat, when the metal will be sublimed.

Arsenic may be detected in minute quantities; though its detection requires many nice and difficult manipulations.

It is well for the inexperienced to avoid the responsibility of

such examinations in important cases, as there are many precautions necessary to an accurate and definite result.

The following are the most important reactions:—

Tests for Arsenious Acid.—Nitrate of silver produces a yellow precipitate, soluble in nitric acid and ammonia; sulphate of copper causes a yellowish-green precipitate; alkaline arsenites with an excess of alkali, throw down when boiled with a few drops of sulphate of copper, a red precipitate of suboxide of copper, oxidizing at the same time the arsenious to arsenic acid; sulphuretted hydrogen and sulphuret of ammonium cause in acid solutions a yellow precipitate of As_2S_3, soluble in alkalies, their carbonates, bicarbonates, and sulphurets, nearly insoluble in muriatic acid, decomposed and dissolved by nitric acid, and depositing a metallic mirror, if mixed with carbonate of sodium and suddenly subjected to an intense heat in a glass tube through which a current of perfectly dry hydrogen passes.

Compounds of arsenious acid, if subjected to the influence of water, zinc, and sulphuric acid, yield arseniuretted hydrogen, AsH, which burns with a bluish color, the flame at the same time giving off white vapors of garlic odor, which condense upon cold objects. Upon a porcelain dish held in the flame, metallic arsenic will be deposited in blackish-brown spots, of a bright metallic lustre. Arseniuretted hydrogen passed through a tube heated to redness yields a bright metallic mirror; this in a feeble stream of sulphuretted hydrogen is converted into yellow sulphuret of arsenic, which is not affected by a current of muriatic acid gas.

Compounds of arsenious acid, if mixed with carbonate of sodium and cyanide of potassium, and heated to redness in a glass tube through which a slow stream of dry carbonic acid passes, yield in the colder parts a beautiful metallic mirror; this is a most delicate test for arsenious acid.

Before the blowpipe upon charcoal, arsenious acid, whether free or in compounds, is reduced and reoxidized, thus producing a characteristic garlic odor.

Tests for Arsenic Acid.—Sulphuretted hydrogen and sulphuret of ammonium cause in acid solutions a yellow precipitate of As_2S_5; nitrate of silver produces a reddish-brown precipitate, sulphate of copper a greenish-blue; sulphurous acid reduces it to arsenious acid; before the blowpipe, with cyanide of potassium and with zinc and sulphuric acid, the reactions are as above.

Preparations of Arsenic.

Acidum arseniosum, As_2O_3. White, opaque, sometimes translucent, masses.

Liquor potassii arsenitis, As_2O_3 and $KHCO_3$ + Aq. Each 64 grs. to Oj; gr. iv AsO_3 to f℥j.

Liquor sodii arsenitis, $As_2O_3Na_2HCO_3$. 60 grains each, to Oj; gr. $3\frac{3}{4}$ As_3 to f℥j.

Acidum arsenicum, As_2O_5. Not used in medicine.

Ammonii arsenias, $2NH_4HAsO_4$. Colorless rhombic prisms.

Liquor ammonii arseniatis, gr. j to f℥j. Biette's arsenical solution.

Sodii arsenias, $Na_2HAsO_4 + 7H_2O$.

Liquor sodii arseniatis, gr. j to f℥j. Contains one-seven-hundredth As.

Ferri arsenias, Fe_32AsO_4. Dark green powder.

Arsenici iodidum, AsI_3. A soluble orange-red salt.

Liquor hydrargyri et arsenici iodidi. AsI_3 and HgI_2, of each, 70 grains to Oj.

Acidum Arseniosum. As_2O_3=198. (*White Arsenic.*)

As before stated, this compound is a collateral product in the smelting of cobalt ores. These ores, which are worked extensively in Bohemia and Saxony, furnish the supplies of arsenic to commerce. It comes in broken masses, with a conchoidal fracture, sometimes translucent, and sometimes, especially when old, opaque, white, or buff-colored. Soluble in about 100 parts of cold water; more soluble in boiling water, which, on cooling, deposits octahedral crystals; its solubility varies very much, however, the transparent variety being the more soluble. It should be preferred for chemical uses in mass, as the powder is liable to adulteration. In medicine, it is used as an alterative and febrifuge. Dose, $\frac{1}{16}$ to $\frac{1}{8}$ grain. Externally it is occasionally applied to cancerous affections.

Arsenious acid is well known to be a violent corrosive poison, and being cheap and abundantly sold as a poison for rats and for other purposes, is apt to be taken accidentally or with criminal design. Its sale is restricted in most of the States by law. The best antidote is *hydrated peroxide of iron*, which, as described in its appropriate place, should be given in tablespoonful doses, repeated every ten minutes, till a large excess has been given.

Liquor Potassii Arsenitis, U. S. P. (*Fowler's Solution.*)

Take of Arsenious acid, in small fragments.
Bicarbonate of potassium, each, sixty-four grains.
Distilled water, a sufficient quantity.
Compound spirit of lavender, half a fluidounce.

Boil the arsenious acid and bicarbonate of potassium in a glass vessel (or porcelain capsule) with half a fluidounce of distilled water, till the acid is entirely dissolved; to the solution, add twelve fluidounces of distilled water; then add the compound spirit of lavender, and afterwards enough distilled water to make it measure a pint.

This very popular medicine is so simple in its mode of preparation as to be conveniently made by the country practitioner. It will be found to facilitate its completion, to triturate the arsenic into a fine powder before introducing it into the flask or capsule. The officinal recipe now directs bicarbonate of potassium, $2KHCO_3$, but it is more common to use the granulated carbonate K_2CO_3, which is usually contaminated with a little silica, and is not uniform in its combining proportion by reason of its deliquescence. Fowler's Mineral Solution has a characteristic reddish, almost opalescent appearance, a faint odor of lavender, and very little taste; by some it is stated to be a solution of arsenious acid in the alkaline solution; by others, a solution of arsenite of potassium. This is a very common alterative and antiperiodic medicine, used in lepra and other cutaneous affections, and much employed in intermittent fever. Four grains of arsenious acid are contained in each fluidounce. Dose, ♏iij to xv.

Liquor Sodii Arsenitis. (*Harle's Solution.*)

This preparation is very similar to Fowler's solution; the principal difference being the substitution of a sodium salt for one of potassium. 30 grains, each, of arsenious acid and dried carbonate of sodium are digested with six ounces of distilled water, and after solution, sufficient cinnamon water is added to make the whole measure eight fluidounces.

It is used for the same purposes and in the same doses as Fowler's solution.

Arsenic Acid. $H_3AsO_4=142$.

If arsenious acid diffused in water is heated, and nitric acid in small quantities added until nitrous acid fumes cease to be given off, the solution contains arsenic acid. An addition of muriatic acid to the water accelerates the reaction, but is not indispensably necessary.

When evaporated to dryness and fusion without carrying the heat too high, arsenic acid appears as a colorless or white vitreous mass, free from water of crystallization, deliquescent, and sometimes forming crystals containing water. It is exceedingly poisonous, has not been used in medicine in its free state, but the following compositions have been prescribed.

Ammonii Arsenias. (*Arseniate of Ammonium.*)

To prepare the dry salt, a concentrated solution of arsenic acid is mixed with strong solution of ammonia until a precipitate commences to appear; on setting aside, colorless oblique rhombic prisms are deposited; they are efflorescent in the air, and lose ammonia.

It is a very poisonous salt, exhibiting in a high degree the alterative effects of arsenic; the dose is $\frac{1}{24}$ to $\frac{1}{16}$ grain.

Liquor Ammonii Arseniatis. (*Biette's Arsenical Solution.*)

One grain of arseniate of ammonium is dissolved in one ounce of water; the dose is 20 minims to half a drachm.

Sodii Arsenias, U. S. P. $Na_2HAsO_4+7H_2O$. (*Arseniate of Soda.*)

This is made by calcining 480 grains of arsenious acid, 408 grains of nitrate of sodium, and 264 grains of dried carbonate of sodium with a full red heat. Put the fused mass while still warm into four fluidounces of distilled water, and stir until dissolved. Filter the solution, and set aside to crystallize. Drain the crystals, and dry rapidly on filtering paper. Keep them in a well-stopped bottle.

Liquor Sodii Arseniatis, U. S. P. (*Pearson's Arsenical Solution.*)

Take of Arseniate of soda, rendered anhydrous by heat not above 300°, sixty-four grains.
Distilled water, a pint.

Dissolve the arseniate of sodium in the water.

This solution contains rather more arsenic than Biette's liquor;

it is considered milder, and given in the same doses; in minute doses, it is asserted to be a reliable remedy against salivation.

Ferri Arsenias. (*Arseniate of Iron.*)

Arseniate of sodium or ammonium produces in the solution of protochloride of iron a white precipitate, which, during washing and drying, assumes a dirty green color by being converted into a ferrosoferric salt. In cancer, psoriasis, etc., it has been given in doses of $\frac{1}{16}$ to $\frac{1}{2}$ grain, usually combined with phosphate of iron; externally it is used in ointments containing about half a drachm to an ounce.

Arsenici Iodidum. AsI_3=456. (*Iodide of Arsenic.*)

Take of Arsenic (the metal), sixty grains.
Iodine, three hundred grains.

Rub the arsenic in a mortar until reduced to a fine powder, then add the iodine, and rub them together till they are thoroughly mixed. Put the mixture into a small flask or test-tube, loosely stopped, and heat it very gently until liquefaction occurs, then incline the vessel in different directions in order that any portion of the iodine which may have condensed on its inner surface may be returned into the fused mass. Lastly, pour the melted iodide on a porcelain slab, and when it is cold break it into pieces and keep it in a well-stopped bottle. (*U. S. P.*)

This is an orange-red crystalline solid, readily reduced to powder, entirely soluble in water, and wholly volatilized by heat. It is seldom prescribed extemporaneously, being little known to practitioners, although doubtless capable of valuable therapeutic applications.

It is made officinal for the purpose of furnishing a ready means of forming the solution which follows:—

Liquor Arsenici et Hydrargyri Iodidi, U. S. P. (*Donovan's Solution.*)

Take of Iodide of arsenic,
Red iodide of mercury, each, thirty-five grains.
Distilled water, half a pint.

Rub the iodides with half a fluidounce of the water, and when they have dissolved, add the remainder of the water and filter. Of course, the mixed powder should be entirely dissolved.

Donovan's solution is a clear, very pale straw-colored, or colorless liquid, with a slightly styptic taste. It should not be prescribed with other chemical preparations, as a general rule. It is a powerful alterative, said to be particularly adapted to the treatment of venereal diseases. Dose, ♏v to xx. Each f℥j contains about $\frac{1}{8}$ grain of arsenic estimated as arsenious acid.

CHAPTER X.

MERCURY, GOLD, AND PLATINUM.

HYDRARGYRUM. Hg = 200 vel 100. (MERCURY.)

MERCURY is obtained chiefly from its bisulphuret, native cinnabar, by distillation with lime; sometimes it is met with in its metallic state, and rarely, combined with chlorine. Very rich cinnabar is found in California, from which a considerable proportion of our mercury is obtained; the mines of New Almaden alone have produced in a single year 30,000 flasks of 76½ lbs. each. The chief uses of mercury are for the extraction of noble metals, the making of vermilion, silvering mirrors, the manufacture of barometers and thermometers, and the preparation of its salts used in medicine.

When pure, mercury is a brilliant white, metallic liquid, becoming solid at —39° F., boiling at 662° F.; sp. gr. 13.5; entirely vaporized by heat; when small globules of it are rolled slowly on a sheet of paper, not a particle should adhere. It dissolves many metals, as tin, bismuth, zinc, silver, and gold, forming amalgams with them. It may be separated from these, when they contaminate it, by distillation. It is not attacked by muriatic nor by cold sulphuric acid, though the latter acid, at a boiling temperature, forms with it a persulphate, sometimes called bipersulphate. Nitric acid oxidizes and dissolves it, forming two nitrates. Mercury forms numerous salts, a number of which are officinal preparations.

In the two classes of salts formed by the suboxide (protoxide) and protoxide (deutoxide) of mercury, these oxides are recognized in the following way:—

Tests for the Protoxide.—Sulphuretted hydrogen and sulphuret of ammonium cause a black precipitate, insoluble in diluted acids; alkalies cause a black precipitate; muriatic acid throws down a white precipitate of calomel; iodide of potassium a greenish-yellow, darkened by excess of precipitant; protochloride of tin precipitates the metallic mercury.

Tests for the Deutoxide (*Red Oxide*).—Sulphuretted hydrogen and sulphuret of ammonium at first produce a white precipitate, which on the further addition of the precipitant turns yellow, orange, brown, and black; fixed alkalies, in the absence of ammonia, cause a reddish-brown precipitate, which is yellow with an excess of the precipitant; the precipitate caused by ammonia is white; protochloride of tin at first throws down calomel; when in excess, the metal is reduced.

The following convenient test for the mercurials is very delicate, and well adapted to pill masses, etc.:—

On to a copper coin brightened with a little NO_3, a small portion of the suspected substance is placed and moistened with a drop or

two of water into a pasty consistence; a small fragment of KI is added to it, and on washing it a mercurial stain will remain. Numerous so-called "vegetable," and other "quack" pills will be found to show the presence of calomel in this way. The reaction in the case of blue mass is less rapid, though equally certain.

The combining number adopted by chemists recently for mercury is 200; that which the leading pharmacologists of this country have adopted heretofore is also 200; to prevent any discrepancy it will be seen throughout the *Pharmacopœia* that in the adoption of officinal names, those chosen are such as would be equally applicable in either case. It will be seen that practically there is no difference in the proportions employed, in the preparations, nor in their testings; the results are the same, though the chemical names, and the explanations of the reactions, are different. More recent authorities adopt 200, and in the following syllabus and in the text their views will be followed; this will tend to less confusion, as these views are likely to prevail in future, and will be in harmony with the lessons of those familiar with the *U. S. Dispensatory*.

SYLLABUS OF MERCURIAL COMPOUNDS.

Off. name.	Composition, etc.	Uses.	Doses.
Hydrargyri chloridum corrosivum	$HgCl_2$	Alterative, antiseptic, etc.	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
Hydrargyri chloridum mite...	HgCl	Cathartic and alterative	$\frac{1}{2}$ to 20 grs.
" sulphas flava.....	$Hg_3O_2SO_4$	Emetic and errhine	Emetic, 3 grs.
" iodidum rubrum..	HgI_2	Alterative in syphilis, etc.	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
" iodidum viride....	HgI	"	$\frac{1}{4}$ to 1 gr.
" *iodidum flavum*....	$HgI + HgI_2$	"	$\frac{1}{8}$ to $\frac{1}{4}$ gr.
Iodide of calomel.....	.....	"	$\frac{1}{16}$ to $\frac{1}{2}$ gr.
Biniodide of calomel.....	.....	"	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
Potassii et hydrargyri iodidum	$KI,2HgI_2$	"	$\frac{1}{12}$ to $\frac{1}{4}$ gr.
Syrup of iodohydrargyrate of iron	.....	Alterative	gtt. xx to xxx.
Syrup of iodohydrargyrate of potassium and iron	$HgI_2 + FeI + Aq$	"	ʒj.
Hydrargyri bibromidum	$HgBr_2$	"	$\frac{1}{16}$ to $\frac{1}{4}$ gr.
" *bromidum*.....	HgBr	Cathartic and alterative	$\frac{1}{12}$ to 6 grs.
" cyanidum.....	$HgCy_2$	Alterative	$\frac{1}{16}$ to $\frac{1}{8}$ gr.
" sulphuretum rubrum	HgS	Alterative fumigations	
" *sulphuretum nigrum*	.....	Mild alterative	gr. v to ʒj.
" oxidum rubrum...	HgO	Externally, stimulant	
" " *nigrum*...	Hg_2O	Alterative, sialagogue, etc.	$\frac{1}{4}$ to 3 grs.
" *acetas*.....	$Hg_2O\overline{Ac}$	Alterative	$\frac{1}{6}$ to 1 gr.
" *protonitratis liquor*	$HgNO_3$ in Aq	"	gtt. iij.
" *binitratis liquor*...	$Hg2NO_3$ in Aq	"	
" *phosphas*.	$2(Hg_2O)HPO_3$	"	$\frac{1}{2}$ to 2 grs.
Hydrargyrum ammoniatum...	NH_2HgCl	Externally in ointment	
" cum creta.....	3 parts Hg + 5p$CaCO_3$	Antacid and alterative	$\frac{1}{2}$ to 3 grs.

Hydrargyri Chloridum Corrosivum, U. S. P. (*Hydrargyri Perchloridum*, Ph. Br. $HgCl_2 = 275$. *Chloride, Perchloride, Bichloride of Mercury. Mercuric Chloride. Corrosive Sublimate.*)

By the action of boiling sulphuric acid on mercury, the persulphate ($HgSO_4$) is first formed. When this is heated with common salt, mutual exchange takes place, and chloride of mercury and sulphate of sodium, the former of which sublimes, are produced. The changes are represented in the formula $Hg,SO_4 + 2NaCl = HgCl_2 + Na,SO_4$.

Corrosive sublimate is in heavy white crystalline masses, of a styptic and metallic taste; soluble in about sixteen parts of cold and three of boiling water, in three parts of alcohol, and four of ether; it melts and entirely sublimes when heated. Its watery solution, precipitated by alkalies or lime-water, throws down the red or yellowish binoxide. (*See* Yellow Wash.) When this precipitate is heated, it gives off oxygen, and runs into globules of metallic mercury; a solution of corrosive sublimate precipitates albumen, and forms with it a definite insoluble compound, to which property its use as an antiseptic is due.

It is a very powerful irritant; when taken in large doses, it causes burning at the epigastrium, vomiting, and purging; applied to the skin, it is corrosive. It is less apt to produce salivation than the other preparations of mercury, and in very small doses it is useful as an alterative in chronic affections, syphilitic or not; locally it may be used as a lotion, gargle, injection, or ointment, in chronic skin diseases, ulcerated sore throats, and chronic discharge from mucous membranes.

Dose, $\frac{1}{16}$ gr. to $\frac{1}{4}$ gr. in solution, or pill with crumb of bread. The solution for external use is usually made in the proportion of $\frac{1}{4}$ or $\frac{1}{2}$ gr. to f℥j of water. It is much used in solution with chloride of ammonium, which increases its solubility as a poison for bedbugs; the proportions to be used are one ounce of corrosive sublimate, half an ounce of chloride of ammonium to two pints of water. When taken in poisonous doses, recourse should be had immediately to albuminous liquids; eggs, if at hand, should be administered freely, or a thin paste of wheat flower or milk, care being taken to evacuate the bowels and to carry off completely the precipitated material, which, though comparatively insoluble, is by no means inert.

Hydrargyri Chloridum Mite. $HgCl = 235.5$. (*Mild Chloride of Mercury. Mercurous Chloride. Calomel.*)

To prepare this, the persulphate of mercury first formed, as explained under the head of corrosive chloride, is afterwards, by being rubbed with a second equivalent of the metal, reduced to a condition capable of forming, when heated, the subsulphate (Hg_2SO_4); and this, by the action of the common salt, is converted into the subchloride of mercury, sulphate of sodium being produced at the same time, $Hg_2SO_4 + NaCl = Hg_2Cl + NaSO_4$.

Calomel, when sublimed, occurs in cakes, with a crystalline structure; but as a drug, it is met with in the form of a white, or yellowish-white, heavy powder, without odor or taste; sublimes with heat; treated with potassa, it is blackened, from the precipitation of the protoxide, which, when heated, runs into metallic globules.

Under the name of English or hydro-sublimed calomel, a preparation is found in commerce, which is preferred by some physicians to the kind made in the manner described above; it is prepared in accordance with Wœhler's suggestion, by conducting the calomel vapors during the process of sublimation into a chamber through which steam is passed; or, as proposed by Dann, by condensing the calomel in a current of cold atmospheric air. Any corrosive sublimate present in the vapors is washed out by the condensed water of Wœhler's process.

Calomel must be entirely free of corrosive sublimate; if treated with alcohol or boiling water, the filtrate must yield no precipitate with sulphuretted hydrogen and nitrate of silver. Calomel is entirely volatile; most foreign admixtures are left behind on heating upon platinum foil.

By the action of nitric and muriatic acids, calomel is slowly converted into corrosive sublimate; soluble chlorides, and even continued boiling with water or alcohol, alone have a similar action. Chlorine, hypochlorites, iodine, iodides, hydrocyanic acid, and cyanurets decompose calomel; the chlorides producing corrosive sublimate; it should therefore not be prescribed at the same time with muriate of ammonia or nitro-muriatic acid, which last is specially indicated in torpor of the liver; symptoms of violent gastric irritation have been unexpectedly produced from neglecting this precaution.

The peculiarities of calomel, as a mercurial agent, are, that it produces little local irritation; it acts as a purgative by increasing the secretion of bile and other intestinal fluids, and hence is much relied on in affections of the liver, and obstructions to the portal circulation. It is much combined with other remedies, being greatly modified in its effects by judicious combination with sedatives, cathartics, astringents, etc.

Dose, as a purgative, 5 grs. to ℈j; to produce ptyalism, ½ grain to 1 grain, frequently repeated. It has become customary to administer exceedingly minute quantities of this preparation, so low as $\frac{1}{24}$th of a grain, repeated every hour or two, the constitutional effects being perceptible after a grain has been given in this way. I am informed that its power to salivate is greatly increased by long trituration with sugar of milk, perhaps on account of the extremely fine division to which it is thus brought, and of some chemical change not yet investigated.

Hydrargyri Sulphas Flava. $Hg_3O_2SO_4$. (*Turpeth Mineral.*)

The persulphate of mercury, formed by the action of boiling sulphuric acid on the metal, and mentioned in the two preceding

formulas, is readily decomposed by reducing it to powder and submitting it to the action of warm water, which changes its composition and properties, producing a yellow-colored insoluble subsalt $Hg_3O_2SO_4$. This is used almost exclusively as an errhine, variously diluted with snuff, powdered liquorice root, lycopodium, etc.

Hydrargyri Iodidum Rubrum. $HgI_2=454$. (*Red Iodide or Biniodide of Mercury. Mercuric Iodide.*)

Take of	Corrosive chloride of mercury . . .	A troyounce.
	Iodide of potassium	Ten drachms.
	Distilled water	A sufficient quantity.

Dissolve the chloride of mercury in a pint and a half of water by trituration in a mortar, adding small quantities of this solvent at a time, and pouring it into a precipitating jar, till the salt is completely taken up; then dissolve the iodide of potassium in half a pint of hot water by shaking them together in a vial. Now pour the solution of iodide into the solution of chloride contained in the precipitating jar, both liquids being hot at the time of mixing them; this will produce immediately a brilliant scarlet-colored precipitate of biniodide of mercury, leaving in solution the very soluble chloride of potassium. Now fold a plain filter, and, having poured off the supernatant liquid from the precipitated biniodide, throw the latter on the filter in a funnel, and wash it by adding repeatedly fresh portions of pure water. Wrap the filter up in soft paper, and lay it away with a weight on it, in a warm place to dry.

Biniodide of mercury is a beautiful scarlet-colored powder (in fine crystals, if the boiling hot solution has been allowed to cool slowly); insoluble in water, but soluble in alcohol, and in solutions of iodide of potassium and chloride of sodium. It is wholly sublimed by heat, condensing in scales which are at first yellow, but afterwards red.

The two iodides of mercury resemble the two chlorides in their relative medicinal activity. This is, like corrosive sublimate, a powerful poison.

It is conveniently given in pill, but perhaps more frequently in solution of iodide of potassium with or without the addition of vegetable alterative preparations. Dose, $\frac{1}{16}$ to $\frac{1}{4}$ gr.

Hydrargyri Iodidum Viride. $HgI=327$. (*Subiodide, Protiodide, or Green Iodide of Mercury.*)

Take of	Mercury	A troyounce.
	Iodine	Five drachms.
	Stronger alcohol	Sufficient.

Rub the mercury and iodine together, adding half a fluidounce of stronger alcohol to form a soft paste, and continue the trituration till the ingredients are thoroughly incorporated. Stir the mixture occasionally, and, at the end of two hours, triturate again, with considerable pressure, until it is nearly dry. Then rub it up with stronger alcohol, gradually added, until it is reduced to a uniform thin paste; and having transferred this to a filter, wash it

with stronger alcohol until the washings cease to produce a permanent cloudiness when dropped into a large quantity of water. Lastly, dry the iodide in the dark with a gentle heat, and keep it in a well-stopped bottle, protected from the light. (*U. S. P.*)

By this process, though a slight excess of mercury is used, a small quantity of the red iodide is formed, which is directed to be removed by dissolving it out with the alcohol.

The mercury is conveniently weighed by balancing a small paper pill-box on the scales, and giving to one side of it a little crimp, as shown in Fig. 175; so that a small stream of the metal may be poured out conveniently. The accurate adjustment of the quantity is troublesome. The iodine also requires care in weighing, owing to its corrosive action on the metals. The most convenient method is to balance a pair of watch-glasses by filing away the heavier of the two, or by pasting on to the lighter a small piece of tinfoil, and then to lay them away for weighing corrosive substances. In the absence of this, a piece of thick and well glazed writing-paper may be put on to each plate and balanced. If the scales are kept in a case, as shown in the first chapter, they should be taken out whenever iodine is to be weighed on them, as the vapor becoming diffused through the air inside the case will corrode the metal.

Fig. 175.

Green iodide of mercury is a greenish-yellow powder, insoluble in water, alcohol, or solution of chloride of sodium, but soluble in ether. Officinal stronger alcohol, when shaken with it and separated by filtration, gives but a transient cloudiness on being dropped into water, and when evaporated from a porcelain surface leaves only a faint red stain. Heated quickly, it sublimes in red crystals, which afterwards become yellow by age; it is converted into teriodide, which has a yellow color, and is believed to be more active.

It is used as an alterative, usually in pill. Dose, $\frac{1}{4}$ gr. to 1 gr.; it is incompatible with iodide of potassium, which converts it into biniodide with separation of mercury.

Hydrargyri Iodidum Flavum. $HgI+HgI_2$. (*Yellow Iodide of Mercury.*)

Owing to the instability of the protiodide of mercury, it is not very reliable as a medicine for internal use; as a substitute for it, a yellow iodide has been proposed, which is unalterable by exposure and age. It is made by precipitating protonitrate, or some other protosalt of mercury, by iodide of potassium, to which one-sixth of its weight of iodine has been previously added.

It is a bright lemon-yellow powder, insoluble in water and alcohol; it sublimes when heated in red crystals, which turn yellow on cooling. It is decomposed by hydriodic acid and by iodides which are incompatible with it. It is given in doses of one-eighth or one-quarter grain.

Iodides of Calomel.

Boutigny has proposed for medicinal use two preparations which have been called respectively iodide and biniodide of calomel (subiodide and iodide). The former is prepared by heating four equivalents of calomel in a retort until it commences to sublime, when gradually two equivalents of iodine are added. The salt appears to be a mixture of two equivalents of calomel, one of iodide, and one of chloride of mercury.

The biniodide of calomel is prepared in a similar manner from equal equivalents of calomel and iodide, and must therefore contain one equivalent each of bichloride and biniodide of mercury.

Gobley (see *Am. Journ. Pharm.*, xxx. 168) prepares these iodides by triturating the material together, introducing it into a retort, and heating it in a sand-bath to fusion.

It is evident that the two preparations must be of different intensity in their medicinal properties. They have been given in doses of one-sixteenth to one-eighth grain, and employed externally in the proportion of a scruple to half a drachm in one ounce of ointment.

Potassii et Hydrargyri Iodidum. $KI,2HgI_2$. (*Iodohydrargyrate of Potassium.*)

A hot solution of iodide of potassium dissolves three equivalents of biniodide of mercury, one of which crystallizes out on cooling, afterwards yellow prisms are separated having the composition stated in the syllabus; they are soluble in alcohol and ether, but decomposed by water.

It is said to be less apt to produce salivation than other mercurial preparations. It is given in doses of one-twelfth to one-eighth grain, and in ointment of the same strength as the other mercurial iodides. When intended for use in solution, it has been recommended to make it extemporaneously with an excess of iodide of potassium, or dissolve it in a solution of this iodide. One of its most useful applications is to the testing of organic alkalies, which see.

Syrup of Iodohydrargyrate of Iron.

This preparation is recommended to be made by dissolving one part of red iodide of mercury in three thousand parts of the officinal syrup of iodide of iron. The dose is from twenty to thirty drops as an alterative tonic.

Syrup of Iodohydrargyrate of Potassium and Iron.

J. E. Young, of Williamsburg, N. Y., offers this preparation, made by combining sixty-four grains of iodine in three drachms of water with iron, and filtering the solution into three and a half fluidounces of syrup; two grains of red iodide of mercury, and one and a half grain of iodide of potassium are dissolved in one drachm of water, and added to the syrup, the whole to measure

four fluidounces. Some orange-flower water may be added to improve the flavor. The dose is a teaspoonful.

Hydrargyri Bibromidum. $HgBr_2=360$. (*Bibromide of Mercury.*)

This corrosive poison is prepared by combining two parts of bromine with five parts mercury under water.

It crystallizes from water in white shining scales, from alcohol in needles; is soluble in water, more so in alcohol and ether, and sublimes when heated.

In its action it is stated to be analogous to corrosive sublimate, and is employed in the same doses.

Hydrargyri Bromidum. HgBr=280. (*Bromide of Mercury.*)

Nine parts of bromide of mercury are mixed with five parts of mercury and sublimed, or a subsalt of mercury is precipitated by bromide of potassium.

It appears as a soft white powder or in thin prismatic crystals, insoluble in water and alcohol, but decomposed by the continued action of bromides or iodides.

It is said to resemble calomel in its action, and is given in medium doses of four to five grains.

Hydrargyri Cyanidum. $HgCy_2=252$. (*Cyanide or Cyanuret of Mercury.*)

Take of Ferrocyanide of potassium, five troyounces.
Sulphuric acid, four troyounces and one hundred and twenty grains.
Red oxide of mercury, in fine powder,
Water, each, a sufficient quantity.

Dissolve the ferrocyanide of potassium in twenty fluidounces of water, and add the solution to the sulphuric acid, previously diluted with ten fluidounces of water, and contained in a glass retort. Distil the mixture nearly to dryness into a receiver containing ten fluidounces of water and three troyounces of red oxide of mercury. Set aside two fluidounces of the distilled liquid, and to the remainder add, with agitation, sufficient red oxide to destroy the odor of hydrocyanic acid. Then filter the solution, and, having added the reserved liquid, evaporate the whole in a dark place, in order that crystals may form. Lastly, dry the crystals, and keep them in a well-stopped bottle, protected from the light. (*U. S. P.*)

In white prismatic crystals, wholly soluble in water. When muriatic acid is added to the solution, hydrocyanic acid is evolved, made evident by its odor, and bichloride of mercury is left, which is entirely volatilized by heat. When cyanide of mercury is heated, cyanogen is given off, and a blackish matter is left containing globules of mercury.

Cyanide of mercury is, like the corrosive chloride, a powerful poison, differing from that remedy in producing no epigastric pain in its operation. Some practitioners prefer it to corrosive chloride in the same doses, and for the same purposes.

Its solution should not be precipitated by muriatic acid or caustic potassa.

Hydrargyri Sulphuretum Rubrum. HgS=232. (*Red Sulphide or Sulphuret of Mercury. Artificial Cinnabar.*)

When melted sulphur is brought in contact with mercury, direct union ensues; and if the compound is afterwards sublimed, it consists of dark scarlet, shining, crystalline masses, forming, when powdered, a beautiful scarlet color, known by the name of vermilion. It is insoluble in water and alcohol, volatilizes entirely when heated alone, but with potassa it is reduced to metallic globules.

When the fumes are brought into contact with the surface of the body, the drug acts as a topical alterative, and becomes absorbed, affecting the system the same as other mercurials. It is used as a fumigator in some syphilitic skin diseases; ʒss, thrown on a hot iron, and placed beneath the patient wrapped in a blanket, will effect the object. The vapor should not be allowed to enter the lungs.

Hydrargyri Sulphuretum Nigrum. (*Black Sulphide of Mercury. Ethiops Mineral.*)

Made by rubbing equal parts of mercury and sulphur together till the globules disappear and a powder is formed. This was formerly officinal, but has been omitted from the *Pharmacopœia* since its revision in 1860.

Ethiops is an insoluble black powder, which is rarely used for any purpose. It may be safely given in doses of from gr. v to ʒj, though marked by no very active properties.

Hydrargyri Oxidum Rubrum. HgO=216. (*Peroxide of Mercury. Mercuric Oxide. Red Precipitate.*)

Prepared by dissolving with heat, mercury, ℔iij, in a mixture of nitric acid, ℔ij, and water, Oij; evaporating the liquor, and triturating what remains to a powder. This is put into a very shallow vessel, and heated till red fumes cease to arise, the nitrate is decomposed by heat, nitrous acid fumes being disengaged and oxide of mercury remaining.

Red oxide is in orange-red, shining, crystalline scales; when strongly heated, it yields oxygen and metallic mercury, without the production of red fumes. It is insoluble in water, but soluble in nitric and hydrochloric acids.

It is used only externally, as a stimulant and escharotic; it is much applied as an ointment to the eye; as an escharotic, in powder, alone, or mixed with sugar, to specks in the cornea, over chancres, and fungous ulcers.

The directions of our *Pharmacopœia* enjoin great care in reducing the red oxide of mercury to a very fine powder; as it is very apt to be gritty from containing crystalline portions.

The preparation is produced, uniform, smooth, and satisfactory by the following formula of T. S. Wiegand:—

Take of Bichloride of mercury	550 grains.
Caustic potassa, in solution	116 "

Dissolve the chloride in one pint of boiling water, and pour the solution into the solution of caustic potassa, diluted with two pints of water, wash with water till there is no taste, and dry on a porous tile; the powder is smooth, dense, and well suited for the purpose of admixture with fatty matters.

Hydrargyri Oxidum Nigrum. $Hg_2O=216$. (*Protoxide of Mercury, Mercurous Oxide. Black Oxide of Mercury.*)

Made by triturating colomel with a solution of caustic potassa. Protoxide of mercury precipitates, while chloride of potassium remains in solution, and is removed by washing. This preparation was omitted from the *U. S. Pharmacopœia* in 1860.

Black oxide of mercury is in powder, which becomes olive-colored by the action of light. It is wholly dissipated by heat, metallic globules being sublimed. It is insoluble in water, but is wholly dissolved by acetic acid.

As a medicine, it is like calomel in its action, and is sometimes substituted for it, but is said to be liable, from occasionally containing deutoxide, to operate harshly. ℥ij, placed on a hot iron, answers the purposes of a mercurial vapor bath. Triturated with lard, it replaces mercurial ointment. Its dose, as an alterative, is a quarter to a half grain daily; as a sialagogue, gr. j to iij, three times a day, in pill.

Hydrargyri Acetas. $Hg_2O\overline{Ac}=259$. (*Acetate of Mercury. Mercurous Acetate.*)

This salt crystallizes from a hot solution of protoxide of mercury in acetic acid, or from a mixture of the hot solutions of the protonitrate of mercury and acetate of potassium.

It separates in soft scales, is slightly oxidized by the air, and blackened by the light while moist.

It is used in similar complaints as the other mercurial salts, in the dose of one-sixth of a grain to one grain.

Liquor Hydrargyri Nitratis. $Hg2NO_3$ in Aqua. U. S. P.

Take of Mercury,	three troyounces.
Nitric acid,	five troyounces.
Distilled water,	six fluidrachms.

Dissolve the mercury, with the aid of a gentle heat, in the acid, previously mixed with the distilled water. When reddish vapors cease to arise, evaporate the liquid to seven troyounces and a half, and keep it in a well-stopped bottle.

In this process part of the nitric acid is decomposed, furnishing oxygen to the mercury, and the oxide of mercury combines with

the acid to form the nitrate of protoxide, formerly regarded as binitrate of deutoxide of mercury, in solution. The nitric acid is designedly present in considerable excess.

This solution is made officinal for the preparation of citrine ointment; it is too concentrated for use except with great care as a caustic. It is used in cancerous and other malignant affections, and is similar to, though not identical with, the preparation formerly in use under the name of *Acid Nitrate de Mercure.*

It is a transparent, nearly colorless, acid liquid, having the specific gravity 2.165. It is not precipitated by the addition of distilled water; the diluted solution affords, with potassa, a dirty-yellow precipitate, and with iodide of potassium, a bright-red one, soluble in an excess of the precipitant. When dropped on a bright surface of copper, the diluted solution instantly deposits a coating of mercury.

Liquor Hydragyri Subnitratis. $HgNO_3$ in Aq.

The *German Pharmacopœia* contains a solution of the protonitrate of mercury, prepared by digesting mercury in excess with nitric acid and water, equal parts, and diluting the solution until it has the specific gravity of 1.1, and contains in twelve parts one part of mercury. It is used in venereal diseases in the medium dose of two drops.

If the solution should contain binoxide, this may be detected by precipitating it with chloride of sodium, and testing the filtrate with sulphuretted hydrogen, which will produce a yellowish precipitate changing to black.

Hydrargyri Phosphas. $2(Hg_2O)H,PO_3=497$. (*Mercurous Phosphate. Subphosphate of Mercury.*)

A solution of a subsalt of mercury is precipitated by phosphate of sodium, and the precipitate well washed.

It is a white crystalline powder, insoluble in water, and has been employed in doses of about one grain, once or twice a day.

There is also a mercuric phosphate which is not used in medicine, having the composition $2(Hg)H,PO_3$.

Hydrargyrum Ammoniatum. $NH_2HgCl=251.5$. (*Mercuric Amido-Chloride. White Precipitate of Mercury.*)

When ammonia is added to a solution of corrosive sublimate, a peculiar compound, and not the oxide of mercury, is precipitated.

This is a white, amorphous powder, in irregular masses, frequently bearing the impression of the fabric on which it is drained and dried. It is decomposed and dissipated by heat; is insoluble in water, but decomposed by continued washing; dissolves in hydrochloric acid without effervescence; and, when heated with potassa, gives off ammonia, and becomes yellow from the formation of the red oxide of mercury. Acetic acid which has been digested with it does not yield with iodide of potassium either a yellow or blue

precipitate; it is not blackened when rubbed with lime-water. It is a compound of amidogen or amide (NH_2) with chloride of mercury.

This salt is never used internally; it is applied externally, to chronic skin affections, in the form of ointment. (*See* Unguenta.)

Hydrargyrum cum Creta. (*Mercury with Chalk. Gray Powder.*)

Made by triturating three parts of mercury with five parts of prepared chalk, till it loses its fluidity and metallic lustre, and the whole assumes the form of a dark-gray powder.

This process is one of great labor; and other modes of preparation have been employed. Those which oxidize part of the mercury into red oxide are objectionable, as rendering this mild powder drastic and violent in its action. It is much less used than blue mass, which it resembles in its action. The proportion of mercury is larger than in blue mass, but is said to be equally mild when well made. Dr. J. C. Beck, of Cincinnati, has examined a specimen containing 15 per cent. of red oxide of mercury. A good substitute is formed by mixing powdered blue mass with prepared chalk, extemporaneously.

It is described as a gray powder, partly dissipated by heat. When a small portion is treated with dilute acetic acid in excess, it is partly dissolved, nothing remaining but mercury in the form of minute globules, visible by the aid of a magnifying glass. The solution, on the addition of muriatic acid, is rendered opalescent; and, when filtered after this addition, and treated with hydrosulphuric acid, does not yield a black precipitate.

In a paper by Mr. Joseph P. Remington, read before the Amer. Pharm. Association in Sept. 1868, the formula used by Dr. E. R. Squibb, of Brooklyn, N. Y., is detailed, in which 10 parts of mercury and 2 parts of honey are shaken together in a properly constructed apparatus for six hours; to this mixture 31 parts of precipitated chalk, mixed into a paste with about 38 parts of water, are added and thoroughly mixed; the whole is then transferred to a muslin strainer, dried, and powdered. In nine samples of this preparation examined by Mr. Remington the amount of oxide varied from .265 to 25.69, thus accounting for the great variation complained of by medical practitioners.

Its chief use is in treating the complaints of children, the chalk neutralizing acid in the stomach, while the mercury increases the biliary secretion. Dose, for a child, from half a grain to three grains.

For other mercurial preparations, *see* Pills and Ointments.

Aurum. (Gold=197.)

Gold is a soft metal, of a peculiar yellow color, and a lustre which is not affected by exposure to the air or heat; it is extremely malleable, being readily drawn into very fine wire, or beaten into leaves of $\frac{1}{200000}$th of an inch in thickness, or, if plated on to silver, not exceeding the one twelve-millionth part of an inch. Its specific gravity is 19.5; its fusing point 1300° F. Commercially the

quality of gold is designated by the term *carat*, which expresses its fineness, not weight; pure gold is 24 carat; 23 carat gold contains 23 parts of gold to one of alloy, 18 carat gold 18 of gold to 6 of alloy. At the mint the proportion of pure gold is expressed by thousandths. American coin is 900 thousandths, 900 parts pure gold to 100 of alloy. To find the carat of a specimen of known percentage of pure gold, multiply the weight of pure gold by 24, and divide the product by the weight of the mass. American coin is of 21.6 carats, thus:—

$$\frac{900 \times 24}{1000} = 21.6.$$

To find the percentage of pure gold in gold of known carat, multiply the weight by the carat and divide by 24, thus:—

$$\frac{1000 \times 21.6}{24} = 900.$$

Gold is not attacked by acids, except by nitromuriatic acid, which solution is the starting point for all preparations of gold.

It combines with oxygen in two proportions, forming a suboxide, AuO, and a peroxide, AuO_3.

Gold leaf, like silver leaf, is used for coating pills containing nauseous or strong-smelling substances.

Test for Peroxide of Gold.—Sulphuretted hydrogen and sulphuret of ammonium cause a black precipitate, soluble in sulphuretted alkaline sulphurets; potassa produces a reddish-yellow precipitate; ammonia a precipitate of a similar color, which is fulminating gold; protochloride with a little perchloride of tin, throws down a purple red precipitate, insoluble in muriatic acid.

Preparations of Gold.

Auri pulvis, Au. Obtained by precipitation or by mechanical division.
Auri oxidum, AuO_3. Anhydrous blackish-brown powder, easily decomposed by heat.
Auri chloridum, $AuCl_3$. Yellow or reddish; crystalline, combining with metallic chlorides.
Sodii et auri chloridum, $NaCl, AuCl_3 + 4Aq$. Yellow crystals, not deliquescent.
Auri iodidum, AuI_3. Dark green; readily decomposed, combining with iodides.
Auri cyanidum, AuCy. Yellow, crystalline, insoluble, combining with alkaline cyanides.

Auri Pulvis. (*Pulverized Gold.*)

When solution of gold in nitromuriatic acid is mixed with a solution of protosulphate of iron, a pulverulent precipitate of a cinnamon-brown color is produced, which is metallic gold, *aurum præcipitatum*. By filing pure gold, may likewise be obtained, in a pretty fine powder, *auri limatura;* or by rubbing gold leaf with sulphate of potassium to a fine powder, and dissolving out the potassium salt, *aurum præparatum*.

Gold, in its metallic form, is supposed to act as a tonic and alterative, and to be considerably milder than any of its compounds. Its dose is one-half to one grain two or three times a day.

Auri Oxidum. Au_2O_3=442. (*Sesquioxide or Teroxide of Gold.*)

Chloride of gold, or the solution of gold in nitromuriatic acid, is treated with magnesia, the precipitate washed with water, and then decomposed by nitric acid, which extracts the magnesia, and a reddish-yellow powder is obtained, which, on drying, turns chestnut brown.

It is somewhat irritating, but has the general properties of powdered gold; in scrofula, syphilis, etc., it has been used in doses of one-tenth to one-half grain twice a day.

Liquor Auri Nitro-muriatis.

This is a solution of six grains of chloride of gold in one ounce of nitromuriatic acid, which has been used as a caustic in cancerous affections; it produces a whitish scab.

A stronger solution has been employed for syphilitic and scrofulous ulcers.

Auri Chloridum. $AuCl_3$=303.5. (*Sesquichloride or Terchloride of Gold.*)

This salt is contained in the solution of gold in nitromuriatic acid, from which it is obtained by evaporation to dryness, and constant stirring towards the end of the process. Care should be taken in the evaporation not to waste the salt, which is volatile. It is a reddish crystalline powder, very deliquescent; soluble in water, alcohol, and ether. Metals, many metallic salts, and organic compounds reduce the gold from its solution.

It is caustic, producing much irritation; when given for some time it is apt to salivate; it is very poisonous. The dose is one-twentieth to one-eighth grain once a day, and very cautiously increased to several doses a day.

Variously diluted with chloride of sodium this salt is used in the photographic art.

Sodii et Auri Chloridum. $NaCl,AuCl_3+4Aq$. (*Chloride of Sodium and Gold.*)

This double salt is obtained by preparing the perchloride from three and a half parts of pure gold, dissolving it in water, and mixing therewith one part pure anhydrous chloride of sodium. On evaporating this solution, long four-sided prisms are obtained, which are of a yellow color and unchangeable in the air.

This salt is officinal in some pharmacopœias, most of which, however, direct an excess of chloride of sodium, and to rub the evaporated mass into a fine powder.

Of the preparations of gold, this double chloride is most employed. Its action is similar to that of the perchloride, but much milder. The dose is one-twelfth to one-quarter grain a day of the pure salt.

Auri Iodidum. AuI_3. (*Iodide of Gold.*)

If a solution of perchloride of gold is gradually added to iodide of potassium, the resulting precipitate is at first redissolved on agitation, a soluble double iodide being formed; subsequently the iodide of gold is precipitated, leaving the supernatant liquor free of color.

It is a dark-green powder, easily soluble in hydriodic acid. It must be kept in well-stoppered bottles, as in contact with the air it gradually loses iodine until metallic gold is left behind.

Like other preparations of gold, it is of an alterative effect, but on account of its spontaneous decomposition, it is not very reliable; the dose is about one-sixteenth of a grain.

Auri Cyanidum. AuCy. (*Cyanide of Gold.*)

The cyanide of gold which has been used in medicine appears to be the protocyanide. The percyanide is in white tabular crystals, fusing at 112°, giving off hydrocyanic acid and cyanogen, and is easily soluble in water, alcohol, and ether. That employed medicinally is insoluble in those liquids, but soluble in alkaline cyanides, ammonia, and sulphuret of ammonium; properties which agree with the protocyanide of gold. It is prepared by dissolving fulminating gold, obtained by precipitating a solution of seven parts of gold by ammonia, in a hot solution of six parts of cyanide of potassium, and treating the solution with muriatic acid in excess, which leaves the proto-cyanide as a yellow crystalline powder.

It is stated to be one of the mildest compounds of gold, and has been used as an alterative, resolvent, and emmenagogue, in doses of one-twelfth to one-half grain once or twice a day.

All the above preparations of gold are also used externally in ointments, and in cases of syphilis for frictions on the gums and tongue. For the latter purpose, they are generally mixed with twice or three times their weight of some inert powder, and the friction is commenced with about one-sixth grain of the mixture a day, and gradually increased; the milder preparations are used in somewhat larger proportions. The quantity employed in ointments varies with the nature of the case, the preparation used, and with the effect desired; from two to twenty grains are employed to an ounce of ointment.

Platinum. Pt = 197.4.

This metal is remarkable for its resistance to chemical agents, and for its infusibility. It is soft, of a silver-gray color; very malleable and ductile, though inferior in these respects to gold. Its valuable physical and chemical properties render it indispensable for the preparation of the necessary utensils for a chemical laboratory.

Platinum dissolves in nitromuriatic acid; with oxygen it unites in two proportions, forming an oxide, PtO, and a binoxide, PtO_2; with the halogens and sulphur it forms compounds of corresponding composition.

Tests for Binoxide of Platinum.—Platinum in solution is recognized by the following behavior towards reagents: Sulphuretted hydrogen and sulphuret of ammonium cause a blackish-brown precipitate of PtS_2, insoluble in muriatic and nitric acid, soluble in alkaline sulphurets and potassa. In the presence of chlorides, or of free muriatic acid, potassa and ammonia produce a crystalline yellow precipitate, soluble in alkalies. Solutions containing free muriatic acid are changed by protochloride of tin to a deep brownish-red color.

Platini Perchloridum. $PtCl_4 = 340$.

Bichloride of platinum is obtained by dissolving the metal in aqua regia, and evaporating to dryness. It is a red crystalline mass, turning brown by expelling the water of crystallization; deliquescent; soluble in water and alcohol; it is much used as a test for the inorganic and organic alkalies, with which it forms yellow double chlorides.

It is poisonous, producing convulsions and death in overdoses. In doses of one-eighth to one-fourth grain, given in mucilaginous liquids, it has been employed like chloride of gold in syphilis, epilepsy, etc., also externally, about fifteen grains to one ounce of ointment.

Sodii et Platini Chloridum. $NaCl + PtCl_4 + 6Aq = 486.5$.

By mixing solutions of bichloride of platinum and chloride of sodium yellow prisms are obtained by evaporation, which are soluble in water and alcohol.

Its effects are similar to the former, only milder, and it is given in somewhat larger doses.

CHAPTER XI.

TESTS.

In the last edition of the *British Pharmacopœia* there are appended two series of tests, both in the state of solution; the one series for qualitative examination of substances, the other for quantitative experiment. It has been deemed best to arrange these tests separately in this place rather than scatter them throughout the work under various headings. These solutions will enable the careful pharmacist to determine with certainty the quality of those substances he may be supplied with.

Solution of Acetate of Copper.

Take of Subacetate of copper of commerce, in fine powder, half an ounce (avoirdupois).
Acetic acid, one fluidounce (Imperial).
Distilled water, a sufficient quantity.

Dilute the acid with half a fluidounce of the water; digest the subacetate of copper in the mixture at a temperature not exceeding 212° with repeated stirring, and continue the heat until a dry residue is obtained. Digest this in four fluidounces of boiling distilled water, and by the addition of more of the water make up the solution to five fluidounces, and filter it.

Solution of Acetate of Potassium.

Dissolve half an avoirdupois ounce of acetate of potassium in five fluidounces (Imperial) of distilled water, and filter.

Solution of Acetate of Sodium.

Dissolve half an avoirdupois ounce of acetate of sodium in five fluidounces (Imperial) of distilled water, and filter.

Solution of Albumen.

Mix, by trituration in a mortar, the white of one egg and four fluidounces (Imperial) of distilled water, and filter through clean tow previously moistened with distilled water. This solution should be prepared when wanted for use.

Solution of Ammonio-nitrate of Silver.

Take of Nitrate of silver, in crystals, a quarter of an ounce (avoir.).
Solution of ammonia, half a fluidounce (Imp.), or a sufficiency.
Distilled water, a sufficiency.

Dissolve the nitrate in eight fluidounces of the water, and to the solution add the ammonia until the precipitate first formed is nearly dissolved. Filter, and add distilled water so that the bulk may be ten fluidounces (Imperial).

Solution of Ammonio-nitrate of Copper.

Take of Sulphate of copper, in crystals, half an ounce (avoir.).
Solution of ammonia,
Distilled water, of each, a sufficiency.

Dissolve the sulphate in eight fluidounces (Imperial) of the water, and to the solution add the ammonia until the precipitate first formed is nearly dissolved. Filter, and then add distilled water, so that the bulk may be ten fluidounces (Imperial).

Solution of Ammonio-sulphate of Magnesia.

Take of Sulphate of magnesia, one ounce (avoirdupois).
Chloride of ammonium (muriate of ammonia), half an ounce (avoirdupois).
Solution (water) of ammonia, half a fluidounce.
Distilled water, a sufficiency.

Dissolve the sulphate and the chloride in eight fluidounces (Imperial) of the water, and to the solution add the ammonia and as much distilled water as will make up the bulk to ten fluidounces (Imperial).

Solution of Boracic Acid.

Dissolve fifty grains of boracic acid in one fluidounce (Imperial) of rectified spirit, and filter.

Solution of Bromine.

Upon ten minims of bromine, in a bottle furnished with an accurately fitting glass-stopper, pour five fluidounces (Imperial) of distilled water, and shake several times. Keep the solution excluded from the light.

Solution of Carbonate of Ammonium.

Take of Carbonate of ammonium in small pieces, half an ounce (avoir.).
Distilled water, ten fluidounces (Imperial).

Dissolve and filter.

Solution of Chloride of Ammonium. Solution of Hydrochlorate of Ammonia.

Dissolve one ounce (avoirdupois) of chloride of ammonium in ten fluidounces (Imperial) of distilled water, and filter.

Saturated Solution of Chloride of Calcium.

Dissolve four ounces (avoirdupois) of chloride of calcium in five fluidounces (Imperial) of distilled water, and filter.

Solution of Chloride of Gold.

Take of Fine gold, reduced by a rolling machine to thin laminæ, sixty grains.
Nitric acid, one fluidounce and a half (Imperial).
Hydrochloric acid, seven fluidounces (Imperial).
Distilled water, a sufficiency

Place the gold in a flask with the nitric acid and six fluidounces of the hydrochloric acid, first mixed with four fluidounces of the water, and digest until it is dissolved. Add to the solution the additional fluidounce of hydrochloric acid, evaporate at a heat not exceeding 212° until acid vapors cease to be given off, and dissolve the chloride of gold thus obtained in five fluidounces (Imperial) of distilled water. The solution should be kept in a stoppered bottle.

Solution of Chloride of Tin.

Take of Granulated tin, one ounce (avoirdupois).
Hydrochloric acid, three fluidounces (Imperial).
Distilled water, a sufficiency.

Dilute the acid in the flask with one fluidounce of the water, and having added the tin apply a moderate heat until gas ceases to be evolved. Add as much of the water as will make up the bulk to five fluidounces, and transfer the solution, together with the undissolved tin, to a bottle with an accurately ground stopper.

Solution of Gelatin.

Take of Isinglass (Icthyocolla), in shreds, fifty grains.
Warm distilled water, five fluidounces (Imperial).

Mix and digest for half an hour on a water-bath with repeated shaking, and filter through clean tow moistened with distilled water.

Solution of Iodate of Potash.

Take of Iodine,
Chlorate of potash, each, fifty grains.
Nitric acid, eight minims.
Distilled water, ten fluidounces and a half (Imperial).

Rub the iodine and chlorate of potash together to a fine powder; place the mixture in a Florence flask, and, having poured upon it half a fluidounce of the water acidulated with the nitric acid, digest at a gentle heat until the color of the iodine disappears. Boil for one minute, then transfer the contents of the flask to a capsule, and evaporate to perfect dryness at 212°. Finally, dissolve the residue in the remaining ten fluidounces of distilled water, filter the solution, and keep it in a stoppered bottle.

Solution of Iodide of Potassium.

Dissolve one ounce (avoirdupois) of iodide of potassium in ten fluidounces of distilled water, and filter.

Solution of Oxalate of Ammonia.

Take of Oxalate of ammonia, half an ounce (avoirdupois).
Warm distilled water, one pint (Imperial.)

Dissolve and filter.

Solution of Perchloride of Platinum.

Take of Thin platinum foil, a quarter of an ounce (avoirdupois).
Nitric acid,
Hydrochloric acid, each, a sufficiency.
Distilled water, seven fluidounces (Imperial).

Mix a fluidounce of the nitric acid with four fluidounces of the hydrochloric acid and two fluidounces of the water; pour the mixture into a small flask containing the platinum, and digest at a gentle heat, adding more of the acid mixed in the same proportion, should this be necessary, until the metal is dissolved. Transfer the solution to a porcelain capsule, add to it a fluidrachm of hydrochloric acid, and evaporate on a water-bath until acid vapors cease to be given off. Let the residue be dissolved in the remaining five fluidounces of distilled water, filter, and preserve in a stoppered bottle.

Solution of Phosphate of Soda.

Dissolve one ounce (avoirdupois) of crystallized phosphate of soda in ten fluidounces of distilled water, and filter.

Solution of Red Prussiate of Potash. Solution of Ferridcyanide of Potassium.

Dissolve a quarter of an ounce (avoirdupois) of crystallized red prussiate of potash in five fluidounces (Imperial) of distilled water, and filter.

Solution of Sulphate of Indigo.

Take of Indigo, dry and in fine powder, five grains.
Sulphuric acid, ten fluidounces (Imperial).

Mix the indigo with a fluidrachm of the acid in a small test-tube, and apply the heat of a water-bath for an hour. Pour the blue liquid into the remainder of the acid, agitate the mixture, and, when the undissolved indigo has subsided, decant the clear liquid into a stoppered bottle.

Solution of Sulphate of Iron.

Dissolve ten grains of granulated sulphate of iron in one fluidounce (Imperial) of boiling distilled water, and filter. This solution should be prepared when wanted for use.

Solution of Sulphate of Lime.

Take of Plaster of Paris, a quarter of an ounce (avoirdupois).
Distilled water, one pint (Imperial).

Rub the plaster of Paris in a porcelain mortar for a few minutes with two fluidounces of the water, introduce the mixture thus obtained into a pint bottle (Imperial) containing the rest of the water, shake well several times, and allow the undissolved sulphate to subside; when this has occurred, filter.

Solution of Sulphide of Ammonium.

Take of Solution of ammonia, five fluidounces.

Put three fluidounces of the ammonia into a bottle and conduct into this a stream of sulphuretted hydrogen so long as this gas continues to be absorbed; then add the remainder of the ammonia, and transfer the solution to a green-glass bottle, furnished with a well-ground stopper.

Solution of Tartaric Acid.

Dissolve one ounce (avoirdupois) of crystallized tartaric acid in eight fluidounces of distilled water, add two fluidounces (Imperial) of rectified spirit, and keep the solution in a stoppered bottle. The spirit is added to preserve the solution.

Solution of Yellow Prussiate of Potash. Solution of Ferrocyanide of Potassium.

Dissolve a quarter of an ounce (avoirdupois) of crystallized yellow prussiate of potash in five fluidounces (Imperial) of distilled water, and filter.

Quantitative Tests.—The design in directing this series of tests is to supply suitable solutions with which to determine the quantity of any particular substance that may be under examination. Being all in solution, they are known as volumetric solutions in the *British Pharmacopœia.*

The solutions are made so that each grain-measure represents a definite quantity of the article in solution, and when a given number of measures is used, the *quantity* of the reagent is at once known. To make the tests as easy and simple as possible, the solution is generally made to the measure of 10,000 grains, and these solutions should be rendered uniform before being used, and preserved in closely-stopped bottles to prevent change by atmospheric action or evaporation.

Volumetric Solution of Bichromate of Potassa. $KO2CrO_3 = 147.5$.

Take of Bichromate of potassa, 147.5 grains.
Distilled water, a sufficiency.

Put the bichromate into a 10,000-grain flask, and, having half filled the flask with the water, allow the salt to dissolve; then dilute the solution with more water until it has the exact bulk of 10,000 grain-measures.

The quantity of this which fills the burette to 0 (1000 grain-measures) contains one-tenth of an equivalent in grains (14.75 grains) of the bichromate of potash, and when added to a protosalt of iron acidulated with hydrochloric acid, is capable of converting one-tenth of six equivalents of iron (16.8 grains) from the state of a protosalt to that of a persalt (sesquisalt). In practising this volumetric process, it is known that the whole of the protosalt has been converted into a persalt when a minute drop of the solution placed in contact with a drop of the solution of ferridcyanide of potassium on a white plate ceases to strike with it a blue color.

By this test it is very evident that the quantity of any ferrous salt may be estimated in whatever compound it may be present. In the case of ferrous salts the rationale is this: two equivalents of bichromate of potassa, which contain two equivalents of chromium and six of oxygen, yield three equivalents of oxygen, and become three equivalents of sesquioxide of chromium to the six equivalents of the ferrous salt (6FeO), converting them into three of the ferric salt ($3Fe_2O_3$).

Volumetric Solution of Hyposulphite of Soda. $NaOS_2O_2 + 5H_2O = 124$.

Take of Hyposulphite of soda, in crystals, two hundred and sixty grains.
Distilled water, a sufficiency.

Dissolve the hyposulphite in 10,000 grain-measures of distilled water. Fill a burette with this solution, and drop it cautiously into 1000 grain-measures of the volumetric solution of iodine until the brown color is just discharged. Note the number of grain-measures (n) required to produce this effect; then put 8000 grain-measures of the same solution into a graduated jar, and augment

this quantity by the addition of distilled water until it amounts to $\frac{8000 \times 1000}{n}$ grain-measures. If, for example, n=950, the 8000 grain-measures of solution should be diluted to the bulk of $\frac{8000 \times 1000}{950}$ =8421 grain-measures. Of this solution 1000 grain-measures contain 24.8 grains of the hyposulphite ($\frac{1}{10}$ of $2(NaOS_2O_2+5H_2O)$, in grains, and therefore correspond to 12.7 grains of iodine ($\frac{1}{10}$th of an equivalent). This solution is used for estimating free iodine, an object which it accomplishes by forming with iodine, iodide of sodium and tetrathionate of soda. 1000 grain-measures of it include one-tenth of two equivalents of the hyposulphite in grains, and therefore correspond to 12.7 grains of free iodine.

Volumetric Solution of Iodine. I=127.

Take of Iodine	127 grains.
Iodide of potassium	180 grains.
Distilled water	A sufficiency.

Put the iodide of potassium and iodine into the 10,000-grain flask, fill the flask to about two-thirds of its bulk with the distilled water, gently agitate until solution is complete, and then dilute the solution with more of the water, until it has the exact volume of 10,000 grain-measures. Of this solution 1000 grain-measures contain $\frac{1}{10}$th of an equivalent in grains (12.7) of iodine, and therefore correspond to 1.7 grain of sulphuretted hydrogen, 3.2 grains of sulphurous, and 4.95 grains of arsenious acid.

This solution was made for use in determining the amount of sulphuretted hydrogen or of a metallic sulphuret in a liquid, but its principal use is for estimating the quantity of sulphurous and arsenious acids. It is to be dropped from the burette into the liquid under examination until free iodine begins to be apparent in the solution.

Volumetric Solution of Nitrate of Silver. $AgONO_5$=170.

Take of Nitrate of silver	170 grains.
Distilled water	A sufficiency.

Put the nitrate into a 10,000-grain flask, and having half filled the flask with the water, allow the salt to dissolve; then dilute the solution with more of the water until it has the exact bulk of 10,000 grain-measures. The solution should be kept in an opaque stoppered bottle. Of this solution 1000 grain-measures contain $\frac{1}{10}$th of an equivalent in grains of nitrate of silver (17 grains). When this solution is dropped into dilute hydrocyanic acid rendered alkaline by soda, the precipitate at first formed is redissolved, and continues to be so until the whole of the cyanogen of the acid has united with the sodium and silver, forming the double cyanide of sodium and silver. In such experiments 1000 grain-measures of the solution indicate that 5.4 grains of absolute hydrocyanic acid have entered into combination.

Volumetric Solution of Oxalic Acid. $2HO,C_4O_6+4HO=126$.

Take of Purified oxalic acid, in crystals quite dry, but not effloresced, six hundred and thirty grains.
Distilled water, a sufficiency.

Put the oxalic acid into a 10,000-grain flask, fill the flask to about two-thirds of its bulk with the water, allow the acid to dissolve, and then dilute the solution with more of the water until it has the exact volume of 10,000 grain-measures. Of this solution 1000 grain-measures contain half an equivalent in grains (63) of oxalic acid, and are therefore capable of neutralizing one equivalent in grains of an alkali or an alkaline carbonate.

Volumetric Solution of Soda. $NaO,HO=40$.

Take of Solution of soda,
Distilled water, of each, a sufficiency.

Fill a burette with the solution of soda, and cautiously drop this into 63 grains of purified oxalic acid dissolved in about two ounces of the water, until the acid is exactly neutralized, as indicated by litmus. Note the number of grain-measures (n) of the solution used, and having then introduced 9000 grain-measures of the solution of soda into a graduated jar, augment this quantity by the addition of water until it becomes $\frac{9000\times1000}{n}$ grain-measures. If, for example, n=930, the 9000 grain-measures should be augmented: $\frac{9000\times1000}{930}=9677$ grain-measures. Of this solution 1000 grain-measures contain one equivalent in grains (40 grains) of hydrate of soda, and will, therefore, neutralize one equivalent in grains of any monobasic acid. (*Br.*)

PART IV.

PHARMACY IN ITS RELATIONS TO ORGANIC CHEMISTRY.

CHAPTER I.

LIGNEOUS FIBRE AND ITS DERIVATIVES.

Organic chemistry refers to the properties and composition of substances which have been formed in vegetables and animals under the influence of life, and their derivatives; the vast variety of these compounds, and the fact that their differences are not so much in the variety of their ultimate constituents as in the number of atoms of these and their peculiar and inexplicable modes of combination, make their study almost a distinct branch of chemical science.

Most vegetable substances used in medicine come into the hands of the pharmacist in a crude condition, and the first scientific inquiry in connection with their modes of preparation relates to the action of solvents upon them, which to some extent involves investigation of their chemical characteristics.

All plants are composed of organic proximate principles, which, when further resolved, are found to consist of carbon, oxygen, and hydrogen; when the two latter elements are combined in the proportion in which they exist in water, they are termed carbohydrates; others consist of carbon and hydrogen only, while another class is distinguished by containing also nitrogen, and some of these phosphorus and sulphur.

The predominance of one or other of these proximate principles in any group of animal or of vegetable products, usually adapts its individual members to certain modes of preparation and use in medicine, and constitutes a strong feature of resemblance among them. This characteristic is still more marked when associated, as it often is, with similar botanical relations, but even in the absence of these it is very apparent; substances which owe their utility to the starch they contain are naturally associated as *farinaceous*, while the *gums* are well and familiarly classed together. So with the *aromatics*, containing essential oils and resins; the *narcotics*, containing vegetable alkalies, etc.

The proximate principles of plants are capable of division into two main classes: these are, *First*, Those which are nutritious or inert, and are generally diffused throughout the vegetable king-

dom, including a few obtained from animals also; this class consists of cellulose, starch, gums, sugar, fixed oils and fats, and the nitrogenized or protein compounds. *Second*, Those which are generally not nutritious, but medicinal or poisonous, and are less diffused, being in some instances confined to a very few families of plants; these are the crystallizable and uncrystallizable neutral principles, the vegetable acids and alkalies, the essential oils and resins, etc.

In treating of these principles, and some of the important drugs in which they are found, the organic materia medica will be brought into view in a different aspect from that under which it is usually studied.

Cellulose. $C_6H_{10}O_5$. (Cellulin. Lignin.)

This is an inert, colorless, sometimes translucent, tasteless, inodorous, organized substance, which is present in the cell walls of all plants, and is the basis of woody fibre.

By long continued boiling with diluted sulphuric acid it becomes "crummy," and finally is converted into soluble cellulose, *dextrin;* for its behavior with cold diluted sulphuric acid *see* Parchment Paper; cold concentrated sulphuric and muriatic acids render it gelatinous and finally dissolve it This solution contains dextrin, a modified lignin which is soluble in water, and another form precipitated by water.

Schweizer's solvent for lignin is an ammoniacal solution of oxide of copper, the solvent action of which is in proportion to the amount of copper it contains, but decreases with age in consequence of the absorption of carbonic acid, and is prevented by acids, salts, or sugar. Acids precipitate the lignin in an amorphous condition, drying to a horn-like mass. These solutions are precipitated by the addition of salts, gum Arabic, dextrin, and alcohol.

The substances belonging under this head, and allied compounds, are soluble in Schweizer's solvent in the following order: silk, cotton, paper, linen, animal bladder, and wool, the latter requiring the aid of heat; muslin dissolves readily; starch is insoluble, but forms a paste when aided by heat; gun-cotton is insoluble in this solution.

With pure cellulose a solution of iodine in iodide of potassium and chloride of zinc produces a blue color, which appears also after brisk boiling with strong potash lye, on the addition of iodine. When boiled with solution of potassa, lignin is decomposed into numerous acid compounds, containing from one to four equivalents of carbon; fusing hydrate of potassa forms with lignin oxalic acid.

Pharmaceutical manipulations are chiefly directed to freeing from lignin, by the aid of various menstrua, those active principles which it incloses, excluded from external influences, and safely locked up in their natural repositories till needed for the relief of suffering or the restoration of health.

Lignin is officinal under the name of *gossypium*, cotton, which, in its condition of raw cotton, or carded cotton, is much used in surgery, and forms the basis of the singular and interesting com-

pounds known as gun-cotton, pyroxylin, and the other forms of prepared cotton entering into collodion and blistering collodion.

Another form of lignin, which is of interest to the surgeon, is that of patent lint, prepared from the fibres of the flax plant (*Linum usitassimum*), or from old white linen cloth scraped so as to make it soft and woolly; much of the lint of commerce contains a certain portion of cotton fibre, which the manufacturers assert is not injurious for the purposes for which it is used.

Paper may be mentioned under this head as one of the most important forms of lignin. Wrapping paper is referred to among the necessary articles of an outfit. This is produced of various qualities, but the pharmacist who aims at a high reputation should not be parsimonious in the purchase of an article, by the quality of which his character for neatness is so likely to be estimated.

Parchment paper is a useful modification of ligneous fibre, prepared by exposing common unsized paper to the action of a mixture of two parts by measure of strong sulphuric acid and one of water for no longer time than is taken in drawing it through the acid, and immediately washing in water containing a little soda or ammonia. If the acid varies much from the proper strength, the paper will be charred or else changed into dextrin, and if too long exposed the latter change will take place. It is tough, firm, impervious, and though very similar to parchment, not, like it, decomposed by heat and moisture. It is not a compound of lignin, but consists of fibre changed in its chemical and physical properties.

Water does not filter through parchment paper, but passes gradually through it by endosmotic action. In this passage through the paper it carries with it all dissolved compounds which are crystallizable, while those which exist in an amorphous condition do not penetrate. These latter have been called by Graham *colloids*, the former *crystalloids*, and the process, which is well adapted for separating minute quantities of the latter from the first group, *dialysis*. The crystalloids do not dialize with the same rapidity, and the process may be, therefore, employed for approximately separating two or more crystallizable substances of different dializing power.

One of the most beautiful exhibitions of ligneous fibre is the skeleton separated from leaves by the maceration and decay of the cellular structure, and the purification and bleaching of the remaining fibrous portions. No ornament is more chaste and elegant than a bouquet of these, and, it being within the capacity of any person of taste to produce them, the art is well adapted to occupy the leisure of ladies. See *The Phantom Bouquet*, a small work by the author, published by J. B. Lippincott & Co., Philadelphia.

The most reliable tests for distinguishing cotton from linen are: 1, boiling with concentrated solution of potassa, which colors linen in two minutes deep yellow; cotton remains nearly white; 2, strong sulphuric acid destroys cotton in one-half to two minutes; 3, olive oil renders cotton transparent, but not linen; 4, tincture of madder dyes cotton light yellow, linen yellowish-red; 5, cotton fibres appear,

under the microscope, as flat, ribbon-like joints, frequently spirally turned and with large channel; linen fibres are straight, long, slender tubes. Wool and silk may be distinguished from the above vegetable fibres and all other carbohydrates by perchloride of tin, which bleaches the latter on heating.

The following principles may be considered as peculiar forms of lignin:—

Peculiar Forms of Lignin.

Medullin, the pith of plants after it is freed from all soluble compounds.
Fungin, the skeleton of fungi.
Pollenin, the pollen granules freed from all soluble matter; it still contains some nitrogen.

Pyroxylon, U. S. P. (*Soluble Gun-cotton.*)

Take of Cotton, freed from impurities, half a troyounce.
Nitric acid, three troyounces and a half.
Sulphuric acid, four troyounces.

Mix the acids gradually in a porcelain or glass vessel, and, when the temperature of the mixture has fallen to 90°, add the cotton; by means of a glass rod imbue it thoroughly with the acid, and allow it to macerate for fifteen hours; then transfer it to a larger vessel and wash it first with cold water until the washings cease to have an acid taste, and then with boiling water. Drain the cotton on filtering paper, and dry it by means of a water-bath.

If the acids of the proper strength cannot be easily obtained, use, for the above quantity of cotton, of nitric acid, having a specific gravity from 1.382 to 1.390, four troyounces, and sulphuric acid, having specific gravity 1.833, two troyounces, and proceed as directed.

By the above treatment one, two, or three atoms of hydrogen are replaced by an equal number of equivalents of peroxide of nitrogen (NO_2), the resulting preparations being, respectively—

Mononitrocellulin . . . . . $C_6H_{10}O_5 + HNO_3 = C_6\left\{\begin{matrix}H_9\\NO_2\end{matrix}\right\}O_5 + H_2O$

Dinitrocellulin . . . . . $C_6H_{10}O_5 + 2HNO_3 = C_6\left\{\begin{matrix}H_8\\NO_2\end{matrix}\right\}O_5 + 2H_2O$

Trinitrocellulin . . . . . $C_6H_{10}O_5 + 3HNO_3 = C_6\left\{\begin{matrix}H_7\\NO_2\end{matrix}\right\}O_5 + 3H_2O$

It is the dinitrocellulin that furnishes the pyroxylon of the *Pharmacopœias.*

Collodium, U. S. P. (*Ethereal Solution of Prepared Cotton.*)

Braconnot discovered in 1833 that cotton, linen, and starch might be converted into a substance remarkable for its ready combustibility. This observation attracted little attention until Prof. Schönbein, in 1845, made some practical applications of this substance, from which it received the name *gun-cotton;* its chemical names are *xyloidin*, *pyroxylin*, and *nitrocellulose.*

Its solution in ether was first recommended as an adhesive sub-

stance adapted to the wants of the surgeon, in an article in the *Boston Medical and Surgical Journal* under date of March 22, 1848, by S. L. Bigelow. He then stated that he had accidentally discovered its remarkable adaptation to the rapid union of wounds by the first intention, and had tested its efficacy by a number of experiments, which induced him to make it public. The next number of the same journal, issued one week later, contained an article on the same subject, by John P. Maynard, of Dedham, Mass., in which he claims to have been the first to use the preparation as an adhesive plaster, and proceeds to detail its advantage, as proved by a number of experiments made by himself, and by numerous physicians and surgeons in Boston.

On the first introduction of the article in Philadelphia, my lamented friend, W. W. D. Livermore, then in my employ, and myself, jointly pursued a series of experiments in its preparation, the result of which we announced in a paper, published in the *American Journal of Pharmacy*, vol. xx. p. 181, stating the best formula that we had tried for the preparation of this solution. It prescribed the mixing of equal portions of nitric and sulphuric acids, and the maceration in it of clean bleached cotton for twelve hours. The proper strength of the nitric acid was then known to be a matter of importance, the acid of 1.5 sp. gr. furnishing the most satisfactory results.

This cotton, after washing and thorough drying, was to be dissolved in a certain proportion of ether, free, or nearly free, from water.

The recipe was accompanied by such practical suggestions as our experiments led to, and although some of the views advanced in that paper were afterwards abandoned, the recipe, with slight modifications, has continued to give satisfaction to this time, and is substantially that now most approved by some leading manufacturers.

Other essays soon appeared on the subject in our own and foreign journals, among which, that of M. Mialhe, recommending immersing cotton in a mixture of nitrate of potassium and sulphuric acid was most approved, and his formula found favor with the committee of revision of the *U. S. Pharmacopœia* for 1850.

In the fourth number of the *Am. Journ. of Pharm.*, 1849, I published the result of some further experiments upon the new adhesive solution, giving a modified formula, which was recommended, as allowing the preparation of a larger quantity at one time, and with far less trouble; as avoiding the exposure of the operator to corrosive acid fumes, while stirring the cotton with the semi-fluid mass, which, in the other case, makes it necessary to work either in a well-ventilated apartment, or in the open air; and as facilitating the washing of the product, which comes out from the mixed acids with no solid crystalline ingredient contaminating it, and may be purified with the utmost facility.

The proportions then indicated were as follows: Fuming nitric and sulphuric acids, of each, four fluidounces; clean cotton, half an ounce; ether, three pints; and alcohol, sufficient.

The cotton was directed to be thoroughly saturated with the acids, previously mixed and allowed to become cool, and macerated for twelve hours. The nitrated cotton, being then removed, was to be washed in a large quantity of water and freed from water by successive washings in alcohol and dissolved in the ether.

Few subjects claimed more attention in the chemical and pharmaceutical journals for some years than this, and in view of the great utility of the employment of a film of the collodion in photography, its manufacture soon became an important branch of business.

In the previous editions of this work the principal essays on the subject were noticed in detail, but it has not been deemed important to add to the foregoing, except to call attention to an elegant expedient directed in the formula, suggested by the late W. W. D. Livermore: to drain off the water by pressure, and then to macerate the cotton a few minutes in alcohol, which, by its affinity for the water, rapidly extracts it, and then may be sufficiently separated by expression, as it is not incompatible with the ethereal solution, which, in fact, it improves.

Rehn's patent for this process of washing prepared cotton for collodion dates long since this suggestion, and ever since its public announcement by me in the Philadelphia College of Pharmacy.

The present officinal process for collodion is a modification of that of Mialhe, directing the maceration of the cotton in the mixed nitrate of potassium and sulphuric acid for twelve hours (instead of four minutes as originally prescribed), and adopting Livermore's process of washing by alcohol instead of the dangerous drying by heat as before indicated. The officinal formula is given in detail as one of the practicable processes for collodion, although there are others in use, especially by photographers, which may serve their purposes better.

Dr. Fresenius recommends gun-cotton as a vehicle for applying permanganate of potassium in surgical dressings, since it does not decompose the solution as ordinary cotton does.

Collodium, U. S. P. (*Collodion.*)

Take of Pyroxylon, two hundred grains.
Stronger ether, twelve fluidounces and a half.
Stronger alcohol, three fluidounces and a half.

Mix the ether and alcohol in a suitable bottle, and having added the pyroxylon to the mixture, agitate occasionally until dissolved.

Collodion is a slightly opalescent liquid of a syrupy consistence. By long standing it deposits a layer of fibrous matter and becomes more transparent. This layer should be reincorporated by agitation before the collodion is used. When applied it should form a colorless, transparent, flexible, and strongly contractile film.

Straining and expressing collodion are often necessary when it contains a large amount of undissolved fibre, as the last portions in a bottle from which the clear liquid has been from time to time decanted; a slight precaution may save the operator a great deal

of trouble and mortification from his hands becoming coated with it beyond remedy. When about to squeeze the strainer, or to thrust the hands into the liquid for any purpose, be careful to have a towel at hand, and instantly, on removing them, wipe them thoroughly dry before time is allowed for evaporation and the consequent deposit of the pellicle. This plan will be found effectual.

The contraction of the collodion pellicle in drying is a decided objection to its use in some surgical cases. C. S. Rand was the first to propose Venice turpentine as an addition to obviate this effect.

Collodium Flexile, U. S. P.

Take of Collodion	A pint.
Canada turpentine	320 grains.
Castor oil	160 grains.

Mix them and keep in a well-stopped bottle.

Rand's Modified Collodion.

Take of Prepared cotton	ʒij.
Venice turpentine	ʒij.
Sulphuric ether	fʒv.

Dissolve, first, the cotton in the ether; add the turpentine, and, by slight agitation, complete the solution.

The resulting collodion, when applied to the skin, forms a transparent pellicle, more difficult to remove than that of ordinary collodion. Being more pliable, it yields to the motion of the skin, and will not crack even after several days' application. It might be supposed that the turpentine would render it more irritating, but this does not seem to be the case, owing to the absence of that mechanical stimulus so powerfully displayed in ordinary collodion. The addition of two drachms of mastic to the above may be at times advisable, if the pellicle be required of great toughness and strength; but it dries more slowly, and remains opalescent longer than that containing Venice turpentine alone. This preparation is more suitable for the purpose of a varnish than as an application to the skin, and is especially adapted to coating labels on vials, which it renders impervious to cold and hot water and alcohol. *Castor oil* has also been found to be an excellent addition to collodion for the prevention of this contraction.

Properties.—Collodion is a colorless, opalescent liquid, of a syrupy consistence, becoming thinner by age, with a strong odor of ether; when applied to a dry surface, it evaporates spontaneously, yielding a transparent pellicle without whiteness, possessed of remarkable adhesiveness and contractility, and quite impervious to moisture or to the action of any ordinary solvents, ether and alcohol excepted.

A piece of linen or cotton cloth covered with it, and made to adhere by evaporation to the palm of the hand, will support, after a few minutes, without giving way, a weight of from 20 to 30 pounds. Its adhesive power is so great that the cloth will sometimes be torn before it loosens. Collodion is frequently not a per-

fect solution of cotton; but contains, suspended and floating in it, a quantity of vegetable fibre which has escaped the solvent action of the ether. The liquid portion may be separated from these fibres by decantation or straining, but this is a disadvantage for surgical use. In the evaporation of the liquid, these undissolved fibres, by felting with each other, appear to give a greater degree of tenacity and resistance to the dried mass, without destroying its transparency; and the *Pharmacopœia* directs that the layer of fibrous matter should be re-incorporated by agitation before the collodion is used.

An adhesive stimulating plaster may be made by dissolving a large proportion of mastic in collodion.

Thapsia Plaster.

Take of	Alcohol	3.5 parts.
	Ether	11.5 parts.
	Pyroxylon paper	1 parts.
	Resin thapsia	10 parts.

Spread with a brush on a piece of plaster at the moment it is required.

It is recommended when a local irritant and revulsive are indicated.

Mode of Preservation.—Collodion is one of those liquids which, owing to extreme volatility, it is objectionable to use from a large bottle, not only from the waste by evaporation every time the stopper is drawn, and the consequent inspissation of the liquid; but, also, from the explosive nature of the vapor of ether when it comes in contact with flame; it should, therefore, be put up in small vials, from which it may be used with economy and safety.

Formerly the manufacturers usually put it in ground stoppered vials, of one or two ounce capacity; but an improvement has been made in the substitution for these of cork stoppered, one-ounce vials.

Cork, by its elasticity, can be made to fit the neck of a vial more tightly than the best glass stopper, and is, therefore, less liable to be thrown out on an elevation of temperature of the contained volatile liquid.

Collodion is generally applied by the aid of a camel's-hair brush, but if one of these is allowed to dry, after being immersed in the liquid, it is apt to be too stiff to use again. To obviate this disadvantage, a contrivance, such as is shown in the accompanying figure, is resorted to; it consists of a long f℥j vial, with a cork stopper, which is perforated with the smallest cylinder of the cork borer, or with the rat-tail file, and into this perforation a thin piece of wood with a turned cap about the diameter of the cork is tightly inserted; this plug of wood has the diameter of the quill of a camel's-hair brush of medium size, and it is long enough to project below the cork, so that the quill will fit on to it and be secure. The bottle being

Fig. 176.

Collodion vial.

now nearly filled and the cork inserted, the brush will dip into the collodion, and, by constant immersion, will keep moist and always ready for use.

Where, from exposure, a part of the ether has evaporated, the addition of more ether will serve to redissolve the gelatinous residue, unless it has dried beyond a certain point, at which it is apt to become quite insoluble.

Uses of Collodion.—The chief use of this interesting liquid is in photography, which has already extended so as to become one of the most important of the modern arts. In medical practice its principal application is to ordinary superficial sores, as cuts and abrasions of the skin, and also to some skin diseases, where the indication is to protect the part from external irritating influences, and where violent itching is one of the most troublesome symptoms. Prof. Simpson, of Edinburgh, recommends it for sore nipples, which it completely protects, without interfering with the sucking of the infant; for this purpose, Rand's preparation would be best suited. It was first principally recommended for the application of bandages, and is used in France as a substitute for dextrin in permanent splints, which, by its use, may be applied over a less extended surface without diminishing the strength and permanence of the dressing.

In cases of burns, where the cuticle has been removed and the symptoms of acute pain allayed by suitable applications, collodion is capable of one of its most useful applications, though for this purpose its contractility should be obviated by adding Venice turpentine or castor oil, as before indicated.

By combining collodion with the ethereal tincture of chloride of iron, a compound is produced which is said to furnish a much more resisting and pliable, though thinner pellicle, and one adapted to the treatment of erysipelas.

Collodion Tinctura Præparat. (London Skin Hospital.)

Take of	Collodion	One ounce.
	Palm oil	10 grains.
	Alkanet root	To color it.

Mix.

Causticum Hydr. Bichloridi. (London Skin Hospital.)

Take of	Corrosive sublimate	One drachm.
	Prep. collodion	6 drachms.

Mix.

The composition of collodion has excited much discussion, and some ingenious hypotheses. The discovery of Prof. Leidy, of this city, of a beautiful crystalline deposit in inspissated collodion, and a similar and independent observation in London, are among the most remarkable facts bearing upon the composition and chemical relations of the group of principles to which lignin belongs.

M. Béchamp, professor in the school of pharmacy at Strasburg, has succeeded in reproducing cotton from pyroxylin, by heating it at the temperature of 212° with a concentrated solution of proto-

chloride of iron. The chloride deepens in color, and very soon there is a disengagement of pure nitric oxide. When this has ceased, and the cotton has been washed with hydrochloric acid, to remove the peroxide of iron impregnating it, the cotton is found to have lost the properties of pyroxylin. In the same way amidon has been produced from xyloidin.

Iodinal Collodion. (J. T. Shinn.)

Take of	Iodine	Half an ounce.
	Canada balsam	Half an ounce.
	Collodion	A pint.

Dissolve the iodine and balsam in the collodion.

Used as a substitute for iodine ointment.

Belladonnal Collodion. (J. T. Shinn.)

Take of	Select belladonna leaves, powdered	Eight ounces.
	Ether	Twelve fluidounces.
	Alcohol (95 per cent.)	Sufficient.
	Canada balsam	Half an ounce.
	Collodion wool (prepared cotton)	A drachm.

Macerate the leaves in the ether with four fluidounces of alcohol, for six hours, pack in a percolator, and pour on alcohol till a pint of tincture is obtained; in this dissolve the cotton and balsam. This is a desirable substitute for belladonna plaster. A similar preparation may be made, free from color, by dissolving atropia in collodion.

Aconital Collodion may be made from aconite root by a similar formula.

Collodium cum Cantharide, U. S. P. (*Cantharidal Collodion. Blistering Collodion.*)

Take of Cantharides, in fine powder, eight troyounces.
Cotton, prepared by the process for collodion, and dry, one hundred grains.
Canada turpentine, three hundred and twenty grains.
Castor oil, one hundred and sixty grains.
Stronger ether, a pint and a half.
Stronger alcohol, a sufficient quantity.

Introduce the cantharides into a cylindrical percolator, and, having pressed them firmly, gradually pour on the ether. When fifteen fluidounces have passed, set aside the liquid in a close vessel, and continue the percolation with stronger alcohol until half a pint more of liquid is obtained. Set this in a warm place for spontaneous evaporation, and, when it is reduced to a fluidounce, mix it with the reserved liquid. Then add the pyroxylon, Canada turpentine, and castor oil to the mixture, and agitate occasionally until it is dissolved. Lastly, keep the solution in a well-stopped bottle.

By this formula, blistering collodion can be readily and uniformly produced by any one having the prepared cotton at hand; this may be purchased of dealers in photographic materials, or made by the process for pyroxylon.

The great merit of blistering collodion is its applicability to circumscribed surfaces, the fact that it requires no covering of any kind, and that it cannot be improperly removed by the patient, as in cases of insanity, etc. Its action is greatly hastened by repeating the application till the coating is thick, and covering the pellicle before it is dry with a piece of oiled silk or bladder.

Styptic Collodion.

Take of Tannin	ʒij.
Stronger alcohol	fʒiv.
Stronger ether	fʒxij.
Pyroxylon	12.5 grains.
Canada balsam	7.5 grains.

Introduce the pyroxylon into a suitable bottle, pour on it two fluidrachms of the alcohol, shake well, then add ten fluidrachms of the ether, agitate frequently until dissolved; dissolve the tannic acid in a mixture of the remainder of the alcohol and ether, mix with the first liquid, add the balsam, allow to stand till clear, then pour off.

The above formula for styptic collodion, with a number of others, was suggested by Mr. C. L. Mitchell, in an inaugural treatise presented to the Philadelphia College of Pharmacy, and published in vol. 44, fol. 241, *Amer. Journ. of Pharmacy.*

Products of the Distillation of Wood.

By the distillation of wood in close vessels, a variety of interesting compounds are produced, which are useful in the arts and in medicine. Of these, charcoal (carbo ligni), acetic acid, pyroacetic and pyroxylic spirit, and creasote may be mentioned as of special interest to the physician, and a short notice of each is appended.

Carbo Ligni, Wood Charcoal, and Carbo Animalis, Animal Charcoal.

The former of these two kinds of charcoal is used in medicine, while the latter is most employed in chemical processes as a decolorizing agent.

Willow charcoal, the variety preferred in this country, is chiefly obtained from the manufacturers of gunpowder, who devote much attention to the production of a pure and fine powdered article. In Europe the charcoal obtained from the linden tree, *Tilia Europæa*, is usually employed in medicine. A charcoal prepared from areca nuts is much esteemed as a dentifrice in England.

Charcoal is wholly insoluble, tasteless, and inodorous; it absorbs moisture and gases from the air, and a small portion of it consists of the incombustible saline materials of the wood, from which it may be freed by digestion in diluted muriatic acid, although this precaution is not necessary as a preparation for medicinal use.

The dose of powdered charcoal as an absorbent disinfectant is about a teaspoonful; as an aperient, a tablespoonful, or less, mixed with magnesia.

Animal charcoal, or *bone-black*, is made from bones by calcination, and, besides carbon, contains phosphate and carbonate of calcium in abundance; these important constituents have much to do with the peculiar porosity which gives to this substance the power of absorbing coloring matters and gases, and adapts it for the various uses in the arts and in pharmaceutical chemistry to which it is applied. It is not very convenient to use in fine powder, and is hence generally prepared in a granular condition.

Carbo animalis purificatus, U. S. P., is among the preparations designed to be made by the apothecary. It is prepared by digesting a pound of animal charcoal with twelve fluidounces each of muriatic acid and water, for two days, at a moderate heat, pouring off the liquid, and washing the charcoal thoroughly with water.

This is adapted to many uses to which the crude powder would be unsuited, owing to its saline ingredients.

In the preparation of the alkaloids, gallic acid, and numerous other chemical substances, animal charcoal is used to absorb the associated coloring matters; but it should not be forgotten that the same property which adapts it to take up the coloring matter also occasions, to some extent, the absorption of the alkaloid or other principle, so that the loss by the decolorizing process is sometimes considerable, unless means are resorted to for the subsequent extraction of the absorbed portions.

To its absorbent property animal charcoal owes its utility as a disinfectant and antidote to the powerful vegetable poisons, which, as proved by Dr. B. H. Rand, may be rendered innoxious in their effects by a large admixture of this inert but porous powder.

Acidum Acetum. $\overline{Ac}=H,C_2H_3O_2=60$.

The acid liquid distilled over when charcoal is prepared from wood, in close cylinders without access of air, contains this valuable acid in a very impure state. By subjecting this to further distillation, the liquid is collected which is known as wood vinegar, or pyroligneous acid. By saturating this acid with lime, acetate of calcium is produced, which, by decomposition with sulphate of sodium, furnishes sulphate of calcium and acetate of sodium; the latter salt, being crystallized in a state of purity, yields, by distillation with sulphuric acid, pure hydrated acetic acid in solution in water.

The officinal acetic acid is directed in the *Pharmacopœia* to have a specific gravity of 1.047, which, however, is a less satisfactory assurance of its strength than its saturating power, which is such that 100 grains saturate 60 of crystallized bicarbonate of potassium, and contain 36 grains of monohydrated acid.

The *monohydrated acid*, $C_2H_3O_2H_2O$ (glacial), is prepared by the careful distillation of one equivalent of fused acetate of sodium with two of sulphuric acid, and placing the distillate on ice, the congealed product is then suffered to drain by inverting the bottle; the crystals constitute the glacial acid. It is a very caustic, deli-

quescent substance, having the specific gravity 1.067; it contains about 98 per cent. of acetic acid, is volatile, colorless, inflammable, and dissolves camphor, resins, volatile oils, etc. Its chief use is in perfumery, for forming a very pungent perfume for smelling bottles.

Acetic acid of about the officinal strength is now so cheaply and abundantly produced for use in the arts, that it is placed in the *Pharmacopœia* among the articles of materia medica; the process above given is selected from a variety in common use. Acetate of lead is also one of its sources of production.

Acetic acid is also produced by the oxidation of alcoholic liquids, especially cider and wine, and in this impure and diluted form is called *vinegar* (*Acetum*, U. S. P.); in chemical works it is generally classed among the derivatives of alcohol.

Much of the vinegar of commerce is largely adulterated or sophisticated, although, according to the experiments of W. W. D. Livermore, the use of sulphuric acid is less common than has been supposed. Of sixteen specimens of commercial vinegar obtained from different sources, none were adulterated with sulphuric acid. Tested for malic acid, gum, and extractive matter, believed to be always present in cider vinegar, all but two gave evidence of containing one or more of these products by throwing down a precipitate with subacetate of lead, soluble in nitric acid.

The strength of the different specimens was ascertained by him as follows: The numbers represent the number of grains of bicarbonate of potassium saturating 100 grains of vinegar:—

No. 1	9 grains.	No. 10	4 grains.
" 2	4 "	" 11	$5\frac{6}{10}$ "
" 3	8 "	" 12	8 "
" 4	$4\frac{4}{10}$ "	" 13	$8\frac{4}{10}$ "
" 5	6 "	" 14	$5\frac{6}{10}$ "
" 7	8 "	" 15	$8\frac{8}{10}$ "
" 8	$8\frac{7}{10}$ "	" 16	$7\frac{8}{10}$ "
" 9	6 "		

The normal saturating power is about $7\frac{1}{2}$ grains of the bicarbonate to 100 grains of vinegar.

Acetone, or Pyroacetic Spirit, C_3H_6O, *and Methylic Alcohol, Pyroxylic Spirit, or Wood Naphtha*, CH_3,HO.

These are products of the distillation of wood, which are separated from the acid liquors, after they are saturated with lime, by simple distillation and repeated fractional rectification.

It is very difficult, however, to obtain them in a perfectly pure state by this process. Acetone is formed by the dry distillation of acetates, and is rendered pure by rectification over lime, and finally over chloride of calcium.

They are both colorless, or slightly yellow, inflammable, volatile, pungent liquids, closely resembling each other in sensible and medical properties, nearly always mixed and impure, and generally confounded with each other in commerce; they may be known apart by their reactions with chloride of calcium.

While pyroacetic spirit does not dissolve or mix with a saturated solution of chloride of calcium, pyroxylic spirit instantly mixes when dropped into it.

The normal specific gravity of each is about the same, .792 to .798; but, as found in commerce, they oftener reach .820 to .846.

Impure wood naphtha yields, with binoxalate of potassium and sulphuric acid, a crystallizable ether, which, by distillation with water, decomposes into oxalic acid and pure methylic alcohol. Treated with bichromate of potassium, acetone yields acetic and carbonic acids, while methylic alcohol furnishes formic acid.

Under the name of methylic spirit, hydrated oxide of methyl, CH_3HO, pyroxylic spirit is extensively used in England as a cheap substitute for alcohol, and is sometimes substituted for it in the preparation of chloroform. Dr. Hastings, of London, introduced it several years ago as a remedy for consumption, and both this and pyroacetic spirit are sometimes prescribed, though not so much as formerly, in connection with cough medicines. Dose, about 10 to 40 drops.

Creasotum, U. S. P. (*Creasote. Kreosot.*)

This is a secondary empyreumatic product of destructive distillation which the *Pharmacopœia* describes as being obtained from wood tar. As found in commerce, it is an oily liquid obtained indiscriminately from various kinds of tar, especially that from bituminous coal, and varies in composition.

Creasote is colorless and transparent, having a high refractive power and oleaginous consistence. Its odor, when diffused, is peculiarly smoky, its taste burning and caustic; its specific gravity is about 1.046. It is freely soluble in alcohol, ether, acetic acid, caustic potassa, and in water to the extent of six or ten drops to the ounce.

The article now generally sold as creasote is imported from Germany, and is much cheaper than the kind which formerly came from England, and was obtained from wood tar. The present article, which is remarkable for readily assuming a brown color on exposure to the light and air, is prepared from coal tar. It has a specific gravity of 1.062, and boils at 386°. In an article on this subject, in the *New York Journal of Pharmacy*, Oct. 1853, Professor Edward N. Kent has given a method of manufacture and purification which has proved successful in his hands, and expresses the opinion that carbolic acid, as he considers it, is creasote in a purer form than that obtained from wood tar. Recent investigations render it probable that creasote, though not identical, is homologous with phenylic acid, and it is probable that it consists of several analogous alcohols. (*See* Phenylic Acid.)

Under the name of *Carbolic Acid* a crystalline substance resembling creasote, but asserted to be less odorous, has been introduced into commerce by F. Crace Calvert, of Manchester, England. It is, perhaps, more freely soluble in water than ordinary creasote, and is well adapted to use as an antiseptic.

The principal use of creasote internally is to check nausea; for this purpose, about two drops may be dissolved in an ounce of water, and a little gum and sugar added. Dose, a tablespoonful (equal to one drop), frequently repeated.

Dropped upon a fragment of cotton, after dilution with alcohol, ether, or chloroform, and inserted into the cavity of a tooth, it relieves toothache when the pain is occasioned by the exposure of the nerve, and is popularly regarded as the most certain remedy.

Very painful and distressing accidents are liable to occur from attempting to drop this liquid into the cavity of a tooth from a vial.

As an external caustic, creasote may be applied, undiluted, with a camel's-hair pencil; but it is usually prepared in the form of ointment (Unguentum creasoti), or in solution in water (Aqua croasoti). In hemorrhages, it acts as a most efficient styptic, and is successfully applied in solution, in the proportion of about six drops to the ounce of water.

Creasote is one of the remedies which the apothecary is most frequently called upon to apply. Large quantities are also consumed by dentists.

CHAPTER II.

ON FARINACEOUS, MUCILAGINOUS, AND SACCHARINE PRINCIPLES.

Starch, $C_6H_{10}O_5$, having the same composition as cellulose, differs from it widely in physical properties; it exists in a granular form in various parts of plants, especially in seeds, tubers, and bulbous roots, in minute cells, which may be distinguished by a microscope of moderate power. The size and shape of the granules have been made special subjects of investigation by pharmacologists, and their study has been found to aid in the recognition of the different varieties of fecula, and in detecting adulterations. The envelope of these starch granules is insoluble in cold water, but is ruptured by the application of heat, so that the contents are exposed and become dissolved. Hence starch is said to be insoluble in *cold*, but soluble in *hot* water. For this internal matter which gives the characteristic chemical reactions of starch the term amidin has been applied; it forms about 995 parts in every thousand of the entire starch granules. But a solution may be effected with cold water, if the envelope of the granules has been torn by continued trituration with sand or other gritty substances. Certain

Fig. 177.

Starch granules as seen under a microscope.

salts, such as chloride of zinc, produce a perfect solution of starch in the cold. By the action of heat, and a very small proportion of strong infusion of malt, starch is converted into *dextrin*, a soluble principle isomeric with it, intermediate between the gums and grape sugar, and so named from its power of causing the plane of polarization to deviate to the right. This is also formed from cellulose by the action of diluted acids, which also ultimately convert it into *grape sugar*. One of the most striking characteristics of starch is its reaction in cold solution with iodine, with which it forms a rich blue-colored iodide, which loses its color by heat. These two substances thus become tests for each other. With bromine it produces an orange-colored precipitate, which cannot be dried without decomposition. Nitric acid converts starch into oxalic acid, and by heating starch with potassa in excess oxalate of potassium is produced. For an elaborate account of starch and its isomeric principles, *Inulin*, from Inula Helena and other sources, *Lichenin*, from Cetraria Islandica, etc., *see* Gmelin's *Handbook of Chemistry*, Cav. Soc. edition, vol. xv.

All the cereal grains owe their utility as articles of food to the presence of starch mingled with a due proportion of a nitrogenized principle; gluten. In many drugs, starch exists to an extent which interferes with their convenient preparation for use in medicine, while it is an important element in certain demulcent and nutritious articles used in medicine, as food for infants, etc.

Syllabus of Starches, Amylaceous Medicines, etc.

Amylum, starch; the fecula of Triticum vulgare and Zea mays.	The fecula from maize is an excellent substitute for arrowroot, and has almost entirely displaced wheat starch. In Europe, the fecula of the potato is largely used as starch: it yields a transparent jelly with muriatic acid, and is used for adulterating arrowroot; sulphuric acid evolves a disagreeable odor.—*Proc. A. Ph. Ass.*, 1862, 168.
Maranta, arrowroot, the fecula of Maranta arundinacea.	Bermuda arrowroot, the best; next the Jamaica, Liberia, Florida, and Georgia. Must be well preserved from moisture and odorous drugs. See paper by Dr. R. Battey in *Proc. of A. Ph. Ass.*, 1858, 332; and by E. T. Ellis, ibid., 1862, 212. It yields an opaque jelly with concentrated muriatic acid.
Arum esculentum.	Native in the Sandwich Islands, where it is used as food to a great extent after the acrid matter has been dissipated by heat.
Arum maculatum.	Formerly officinal in *Dublin Pharmacopœia.*
Arum tryphyllum.	Officinal in *U. S. P.;* contains about 17 per cent. of fecula.
Canna, tous-les-mois; the fecula of Canna edulis, etc	The starch granules are very large, and exhibit a glistening or satiny appearance. The jelly is very tenacious, but not very translucent. Comes from the island of St. Kitts. Rare with us.
Curcuma arrowroot.	From the East Indies. Used, in England, only for adulterations.
Sago; the prepared pith of Sagus rumphii, etc.	Dietetic and nutritive, in small granules prepared by the aid of heat.
Tapioca; the fecula of the root of Janipha manihot.	Dietetic and nutritive, coarse irregular grains prepared by the aid of heat, partially soluble in cold water.

SYLLABUS OF STARCHES, AMYLACEOUS MEDICINES, ETC. (*Continued.*)

Avenæ farina, oatmeal; the meal of Avena sativa.	Contains the husk ground with the seed. Relieves constipation; easily digested and very nutritive.
Hordeum, barley; the decorticated seeds of Hordeum distichon, etc.	Demulcent, nutritive, and slightly astringent. See Decoctum hordei.
Oryza, rice; the seeds of Oryza sativa, deprived of the hulls.	Bland, nutritive, demulcent, and somewhat astringent. By long boiling forms a jelly.
Cetraria, Iceland moss; Cetraria Islandica.	Contains lichenin and a bitter principle; the latter may be removed by an alkali; the residue may be used as a dietetic.
Chondrus, carrageen; Chondrus crispus.	Contains carrageenin, mucilage, and various salts.
Inula, elecampane; the root of Inula helenium.	Contains, like the root of other compositæ, inulin, bitter principle, and mucilage. A domestic expectorant.
Symphytum officinale, comfrey; the root.	See Inula.
Lappa, burdock; the root of Lappa major.	See Inula.
Iris Florentina, orrisroot; the rhizoma of Iris Florentina.	Contains starch, resins, and volatile oil. Used an an infant and toilet powder, and as an ingredient in dentifrice.

GUMS.

Gums differ from starch chiefly in the absence of the granular condition, and their partial or complete solubility in cold water. They are obtained from certain plants in amorphous masses, mostly exuding spontaneously or upon a puncture of the bark. A solution of gum is not affected by iodine, but precipitated by alcohol. Oxidized by nitric acid, they produce mucic acid; but when continually boiled with diluted acids, a kind of dextrin and, finally, sugar is formed.

There are probably numerous kinds of gums, but on account of their similarity in physical and chemical properties they are difficult to recognize and to separate from allied compounds. They have been classed into gums which are soluble, and gums which mostly swell up in cold water. The following are the types of these two classes:—

Arabin = $C_{12}H_{22}O_{11}$, is derived largely from the acacias; it is extremely soluble in water, forming a clear and colorless though viscid solution, almost free from taste, which is coagulated by alcohol, borax, and precipitated by silicate of potassium, strong solution of perchloride of iron, also, like most organic acids, coloring principles, etc., by subacetate of lead. Incinerated it yields about three parts of ashes, which some chemists assert are the bases of the salt arabin, the acid of which is obtained by decomposing the aqueous solution with muriatic acid and precipitating by alcohol, and is insoluble in the latter menstruum only in the presence of a mineral acid.

Bassorin = $C_{12}H_{10}O_{10}$, is an insoluble variety, swelling with water and dissolving in alkalies. This predominates in gum tragacanth, and, according to some, in salep. Those bodies which are usually termed *Mucilages* belong to one of these two classes; they are met

with in many seeds (flaxseed, quince seed), leaves (buchu), etc., and some kinds are precipitated by neutral acetate of lead.

Cerasin, the insoluble ingredient in cherry-tree gum, much resembles bassorin, if it is not identical with it. M. Fremy asserts it is only metagummate of lime.

Mezquite is a name proposed for a gum, to which attention has been called by Dr. Geo. Shumard, produced abundantly in Texas and New Mexico—parts of our own country as yet but little explored; it is extremely soluble, and differs from Arabin principally in not being precipitated by subacetate of lead.

All the above compounds are carbohydrates of the composition $C_{24}H_{20}O_{20}$, or $C_{24}H_{22}O_{22}$; the group of pectin compounds, though not strictly belonging to the above, is however nearly allied to the gums.

Gum is associated in some plants with resin; and gum resins, a remarkable natural class of drugs, will be hereafter referred to in treating of resins.

Variously associated with other proximate principles, gum is present in a great variety of vegetables, and like starch, it plays an important part in the physiology of the plant; it enters as an element into a great number of articles, both of food and medicine. In its important relations to the art of prescribing and compounding medicines, we shall have occasion to refer to it frequently throughout the subsequent parts of the work, and now introduce it only for the purpose of calling attention to a few drugs containing it.

Pectin and Pectic Acids.—Many plants contain, in different organs, especially in succulent roots and acidulous fruits, a body called pectose, which, through the influence of a peculiar ferment called pectase, the organic acids, and light and heat, undergoes a change into other bodies of the same relative combinations.

Pectin, parapectin, and metapectin	$C_{32}H_{40}O_{28}\ 4H_2O$
Pectosic acid	$C_{32}H_{20}O_{28}\ 3H_2O$
Pectic acid	$C_{16}H_{22}O_{15}\ 2H_2O$
Parapectic acid	$C_{24}H_{15}O_{21}\ 2H_2O$
Metapectic acid	$C_{24}H_{32}O_{27}\ 2H_2O$

The unripe fruits contain only pectose; while ripening, pectin and parapectin, and, subsequently, metapectic acid, are formed, so that the change of the consistence of fruits is less dependent on a change of the cellulose, than owing to this transformation. Green fruits exhale oxygen in daylight; with the alteration of pectose, the formation of sugar sets in, carbonic acid is exhaled, the green color disappears, and the free acids (citric, malic, tartaric, etc.) become neutralized by potassium, calcium, etc., or their taste is masked by the increase in the quantity of sugar.

Pectin is the cause of the gelatinizing of the juices of currants, raspberries, etc., and of gentian, dandelion, rhubarb, and other roots. The salts of the above acids are uncrystallizable; those with the metallic oxides are mostly gelatinous precipitates, while those with alkalies are soluble in water, but gelatinize on cooling.

Syllabus of Gums and Mucilaginous Medicines.

Acacia, gum Arabic; the exudation of Acacia vera, etc.	Mild expectorant and demulcent, used in form of mucilage (1 part to 2 water), also as syrup and powder as a vehicle.
Tragacantha, the exudation of Astragalus verus.	Consists chiefly of bassorin; Mucilago tragacanthæ (℥j to aquæ Oj); a useful paste.
Salep, the tubers of Orchis mascula, etc.	Five grs. of the powder render one ounce of hot water highly mucilaginous. *See* Castillon's Powders.
Ulmus, elm bark; the inner bark of Ulmus fulva.	Contains much mucilage, the fine powder as a mild expectorant and vehicle for bitter medicines; much used for making a demulcent drink to be used in irritation of the mucous surfaces, especially of the urinary organs, and in dysenteric affections; the coarser powder for poultices.
Sassafras medulla, the pith of Sassafras officinale.	Forms with water a rich mucilage; used in eyewashes and in Jackson's pectoral syrup.
Cydonium, quince seed; the seed of Cydonia vulgaris.	Rarely used internally; externally in inflamed eyes and for bandoline.
Sesami folium, benne; the leaves of Sesamum orientale.	Grown in gardens; used as a mild astringent in the summer complaint of children.
Althæa (radix), marshmallow root.	The mucilage of these last three are not precipitated by alcohol.
Althææ flores, marshmallow flowers from Althææ officinalis.	Contain starch, mucilage, and asparagin; highly demulcent. Syrup best prepared from cold infusion.
Althæa rosea, hollyhock; the flowers.	Similar in properties to former.
Hibiscus esculentus; ochra, the fruit.	Used in the U. S. in soups called Gumbo; in East Indies a decoction ℥iij in Oiss, boiled down to Oj, sweetened and strained.
Linum, flaxseed; the seeds of Linum usitatissimum.	Internally in the form of infusion, diuretic, and demulcent; externally, the meal for poultices; the oil readily becomes rancid in the powder.
Papaver, poppy heads; the ripe capsules of Papaver somniferum.	Demulcent, not considered narcotic when ripe.
Buchu, the leaves of Barosma crenata, etc.	Mucilage associated with essential oil; diuretic, used in infusion and fluid extract.

Sugars.

Sugars are of many kinds, closely allied to each other and to the foregoing ternary principles, in composition. They are distinguished by a sweet taste, and a more or less distinctly crystalline form. They are mostly soluble in water and somewhat soluble in alcohol.

Syllabus of Sugars.

(1.) *True Sugars. Composition* $C_{12}H_xO_x$. *(Carbohydrates.)*

a. Directly fermentable. (Group of Glucose.)

Grape sugar, Glucose $C_6H_{12}O_6 + 2H_2O$	In grapes, the fruit of Rosaceæ, etc., in diabetic urine — from starch by the action of sulphuric acid—the granular deposit of honey.	Deviates polarized light to right;* soluble in $1\frac{1}{3}$ part cold water, insoluble in absolute alcohol; with HNO_3, yields oxalic acid.
Fruit sugar, uncrystallizable sugars, Chulariose $C_6H_{12}O_6$	In fruits, the liquid portion of honey, etc.	Rotating left; easily soluble in water and diluted alcohol.

b. Not directly fermentable by yeast. (Group of Cane Sugar.)

α. Fermenting readily with yeast by being converted into fruit sugar.

Cane sugar $C_{12}H_{22}O_{11}$	In sugar-cane, Chinese sugar-cane, corn-stalks, beets, sugar maple, several palms, numerous ripe fruits, etc.	Rotating right; easily soluble in water, little in alcohol; yields oxalic acid with HNO_3.
Melitose $C_{12}H_{12}O_{11}3H_2O$	In Australian manna from Eucalyptus mannifera.	Rotating right; crystallizes in needles; reactions similar to cane sugar.
Synanthrose $C_{12}H_{22}O_{11}$	In the tubers of the Synantherea.	No rotating power; deliquescent; very soluble in water; slightly in alcohol.

β. Fermenting with difficulty in contact with yeast, but readily after treatment with dilute acids.

Melezitose $C_{12}H_{22}O_{11}$	In the exudation of the larch, Larix communis (*Fr. méléze*).	Rotating power right; sweet like glucose; very soluble in water, almost insoluble in alcohol; yields oxalic acid by HNO_3.
Mycose $C_{12}H_{22}O_{11}2H_2O$	In ergot.	Rotating power right; easily soluble in water, almost insoluble in alcohol.
Trehalose $C_{12}H_{22}O_{11}2H_2O$	In Trehala, an oriental excrescence of a species of Echinops.	Resembling the former; soluble in hot alcohol; with HNO_3, yields oxalic acid.
Lactin, sugar of milk $C_{12}H_{24}O_{12}$	In milk.	Rotating power right; very hard prisms; soluble in 6 parts cold water; insoluble in ether; slightly soluble in alcohol; by dilute acids, converted into lactose, and then easily fermentable; yields mucic and some oxalic acid with HNO_3.

* Polarization of light, which is stated as characteristic in the case of the several sugars, consists of a change produced upon light by the action of certain media and surfaces by which it ceases to present the ordinary phenomena of reflection and transmission. Instruments employed to exhibit this change are called *polariscopes*. By the use of these, differences may be readily detected between substances which are nearly identical in chemical properties.

(2.) *Saccharoids. Composition* $C_{12}H_xO_x$. *(Carbohydrates.)*

Not fermentable with yeast or after boiling with HSO_4.

Eucalyne $C_6H_{12}O_6 2H_2O$	In Australian manna accompanying melitose.	Uncrystallizable; even after treatment with HSO_4, not susceptible of fermentation; reduces alkaline tartrate of copper.
Inosite (Phaseomannite) $C_6H_{12}O_6 4H_2O$	In muscular flesh, and in the unripe kidney bean, Phaseolus vulgaris. *See* Dr. L. C. Lane's process in *A. J. Ph.*, ix. 492.	Effloresecing; soluble in water, little soluble in alcohol; not altered by diluted acids; with concentrated HNO_3, nitroinosite; evaporated with dilute HNO_3 and moistened with NH_3 and CaCl, is colored rose-red.
Scyllite	In the kidneys and liver of some fishes.	Resembles inosite; but is less sweet, less soluble, and dissolves unaltered in hot HNO_3.
Sorbin, sorbite $C_6H_{12}O_6$	In the berries of sorbus aucuparia.	Rotating power left; soluble in $\frac{1}{2}$ water, little in boiling alcohol; hard crystals, not altered by diluted HSO_4; yields oxalic acid with HNO_3; reduces oxide of copper.
Phloroglucin $C_6H_6O_3$	Product of decomposition of Phloretin and quercitrin.	Sweet prisms; very soluble in water and alcohol.

(3.) *Pseudo-Sugars of the Composition* $C_{12}H_xO_{x-2}$.

Not fermenting.

Mannite $C_6H_{14}O_6$	In manna, mushrooms, etc.	No rotating power; soluble in 5 parts cold water, scarcely in cold alcohol, with HNO_3 yields saccharic and oxalic acids; HNO_3, at a low temperature, produces a fermentable sugar.
Dulcose, Dulcite $C_6H_{14}O_6$	From an unknown plant in Madagascar.	No rotating power; easily soluble in water, with difficulty in alcohol; yields mucic, oxalic, and racemic acid with HNO_3
Quercite $C_6H_{12}O_5$	In acorns.	Sublimes in needles; with nitric acid, yields oxalic acid.
Pinite $C_6H_{12}O_5$	In Pinus Lambertina.	Rotating power right; very sweet; readily soluble in water; nearly insoluble in boiling alcohol.
Melampyrite $C_{12}H_{30}O_{13}$	In Melampyrum nemorosum; Scrophularia, nodosa, etc	No rotating power; soluble in 25 parts water, 1362 parts alcohol; not altered by diluted HSO_4; with HNO_3, mucic and oxalic acids.

b. Of other compositions.

Glycerin $C_3H_5 3HO$	The basic principle of fats.	Oily liquid; miscible with water and alcohol; insoluble in ether; with HNO_3 yields glonoin.
Erythromannite $C_4H_{10}O_4$	Product of decomposition of erythrin.	Supposed to be identical with phycite.
Phycite $C_4H_{10}O_4$	In Proctococcus vulgaris *Algæ*.	No rotating power: easily soluble in water, with difficulty in alcohol; with HNO_3 oxalic acid.
Glycyrrhizin $C_{24}H_{36}O_9$.	In Glycyrrhiza glabra, and eschinata.	Uncrystallizable and yellowish; slightly soluble in cold water and alcohol; precipitates most metallic salts; combines with bases, acids, and salts.
Panaquilon $C_{24}H_{25}O_{18}$	In Panax quinquefolium.	Amorphous, yellow, readily soluble in water and alcohol; insoluble in ether; precipitated by tannin.
Orcin, Orcite $C_{14}H_8O_4+2Aq$	By boiling certain lichens or their constituents.	Sweet prisms, very soluble in alcohol and water; precipitated by $Pb\overline{Ac}$ and Fe_2Cl_6; yields oxalic acid by HNO_3; deep red by air, water, and ammonia (orceine).
Beta orcine $C_{34}H_{18}O_6$?	By dry distillation of usnic acid.	Soluble in water, alcohol, and ether; red by NH_3H_2O and air.

REMARKS ON THE SUGARS.

Cane sugar is mostly prepared from the juice of the sugar cane; considerable quantities are made in Europe from beet root. The juice is boiled with quicklime, strained, and reduced by evaporation to a thick syrup, when the whole is cooled and granulated in shallow vessels; it is now raw sugar of commerce. By purification or refining, which is accomplished by the aid of animal charcoal, it is obtained as loaf, or more commonly as broken-down or crushed sugar—the condition in which it is mostly preferred for use in pharmacy.

In the granulation of raw sugar, the uncrystallizable portion which remains is drawn off and constitutes molasses of commerce. Molasses, by careful manipulation, is made to yield a further portion of sugar, and then constitutes sugar-house molasses, or, as it is called abroad, treacle.

Cane sugar is one of the sweetest of the sugars; when pure it is white or crystallized in translucent double oblique prisms, soluble in alcohol but not in ether. It is soluble in $\frac{1}{3}$ its weight of water; its solution heated in contact with salts of copper, mercury, gold, and silver, decomposes them. Its watery solution with yeast undergoes the vinous fermentation, the cane sugar being previously converted into fruit sugar. Lump sugar is permanent in the air, and phosphorescent in the dark when struck or rubbed. Its tendency to crystallize or form a translucent candy is prevented by the addition of cream of tartar and acids, or acid salts, generally fruit sugar

and subsequently grape sugar being formed. By the application of a heat of 320° F. it melts and cools to a glassy amorphous mass (*barley sugar*); if heated to 425° it is changed into caramel; long boiling diminishes its tendency to crystallize and increases its color.

Rock candy is a very pleasant form of cane sugar, prepared by crystallizing it slowly upon a string from a strong solution; it is preferred for coughs from the slowness with which it dissolves in the mouth, and is very often used to sweeten mucilaginous and acid drinks used in catarrhs.

The peculiar brown coloring matter called *caramel*, $C_{12}H_9O_9$, is produced by heating sugar to a temperature of 425°, until it fuses, evolves the vapors of water, and turns to a deep brown color; it then consists of unaltered sugar, caramel, and a bitter substance called *assamar;* it is freely soluble in water, and has a bitter and not disagreeable empyreumatic taste. It is much used to color liquors, as in the fabrication of brandy, and is a useful addition to soups.

For the effect of heat on cane sugar, as observed by Gélis and Pohl's method for preparing pure caramel, consult *Proceed. Am. Ph. Ass.*, 1862, 165.

Sugar combines with bases, forming *saccharates*, which are uncrystallizable, and those of the alkalies deliquescent. Saccharate of calcium is used in medicine under the name of Syrupus Calcis (p. 211).

Common salt combines with sugar to a deliquescent crystallizable compound. The alkaline saccharates precipitate the soluble salts of lead, copper, silver, and mercury.

Fruit sugar.—Whether the sweet fruits all contain the same sugar is uncertain; the absence of crystalline forms, constant changes in the process of ripening, and the difficulty of freeing one kind from another impede the investigations; its rotating power is greatly influenced by different degrees of temperature.

Grape sugar is found in grapes and in acid fruits associated with fruit sugar. It constitutes also the *sugar of diabetes.* The most economical method of obtaining it is by acting on starch or lignin with diluted sulphuric acid; it may also be obtained in an impure state, by scraping off the white powder deposited on old raisins, and much purer by drying the deposit of honey upon brick tiles. Grape sugar, under the name of glucose, has of late years become an article of great commercial importance; it is largely consumed by brewers in the production of sparkling ales, etc., and in pharmacy in syrups, in which increased body without corresponding sweetness is desirable. It is found in two forms—a dense transparent syrup, and in whitish or grayish-white masses; and is made in the large way by heating 56 parts of sulphuric acid and 5600 parts of water to 212°. Equal amounts of acid and water are mixed at a temperature of 86° F. in a wooden vessel, and 2200 parts of starch meal are stirred and heated to 100° F.; the latter mixture is then gradually added to the first, and heated to 212° for a short time, and then to 320° for two or three hours, or until the starch has been

converted to glucose; this is then drawn off into tanks, and 168 parts of pure chalk stirred up with 500 parts of water are gradually added; when all the acid has been neutralized, the sulphate of calcium is filtered out on a muslin filter, and the solution concentrated and clarified by bone-black and renewed filtration.

As already stated, by the action of diluted acids upon lignin and starch, they are converted into a soluble form called dextrin, and ultimately pass into grape sugar, this change may be produced by long boiling alone; it is also produced in starch by nitrogenized ferments, especially by that peculiar substance known as diastase. By the same means, cane sugar is spontaneously converted into fruit sugar, and this into alcohol, and ultimately into acetic acid; and, in fact, the alcoholic and acetic liquors of commerce are produced in this way from the various starchy and saccharine vegetable products used in their manufacture. Glucose combines with alkalies in the cold, but these compounds are decomposed by heat.

Sugar of milk is not manufactured in this country, but is chiefly imported from Switzerland, where it is made on a large scale from whey; it is crystallized upon sticks or strings in masses not unlike stalactites in appearance. The greatest consumption of this is by the homœopathists, who use it as a vehicle for almost all their medicines in the form of powders and pillets. It is said by them to have the least action upon the system of any substance they have experimented with; and hence its employment as a diluent for the infinitesimal doses, which, according to their theory, are increasingly powerful in proportion to their dilution. Its physical condition of hardness or resistance to mechanical action adapts it to develop the latent efficiency of those medicines which they assert are only rendered active by long attrition. (*See* the observations of Dr. R. Luboldt on its fermentation, in *Am. Jour. Ph.*, 1861, 409.)

Glycyrrhizin may be prepared, according to Mr. Jos. Hirsch, by making a hot infusion with dilute acetic acid, neutralizing with soda, crystallizing out the acetate of sodium, and concentrating the infusion containing the glycyrrhizin.

Another process is to percolate liquorice root with alcohol, heat to the boiling point, filter, and evaporate.

Mannite may be prepared by several processes:—

First. By digesting manna in boiling alcohol, and filtering while hot. As the liquid cools it precipitates the mannite in tufts of slender colorless needles; these may be purified, if necessary, by resolution and crystallization.

Second. By mixing manna with cold water in which the white of an egg has been beaten, boiling for a few minutes, and straining the solution through linen while hot; the strained liquid forms a semi-crystalline mass on cooling; this is to be pressed strongly in a cloth, then mixed with its own weight of cold water and again pressed, then mixed with a little animal charcoal dissolved in boiling water, and filtered while hot into a porcelain dish over the fire; the solution is now to be evaporated till a pellicle forms, and set aside to crystallize in large transparent quadrangular prisms.

Third. By dissolving manna in water, precipitating gummy and coloring matters with subacetate of lead, removing lead from the filtrate by carefully dropping into it sufficient sulphuric acid, though not in great excess, evaporating and crystallizing.

Fourth. Artificially, by acting upon glucose prepared from dextrin and concentrated to 15° Baumé, with five per cent. of wheat flour, five of molasses, and five of common malt vinegar at 100° F.; after fermentation for three days, concentrating, and digesting with alcohol, crystals of mannite are obtained. (*Am. Jour. Pharm.*, February, 1871.)

Mannite fuses between 320° and 330° F., and crystallizes again at about 284°. In sealed tubes mannite may be heated to 482° without altering, except that a small portion turns into mannitan $=C_6H_{12}O_5$ (anhydrous mannite), which may be obtained by many processes calculated to abstract the water of crystallization: it is a neutral syrupy sweetish substance, scarcely liquid, insoluble in ether, slowly soluble in anhydrous alcohol, freely soluble in water, in contact with air it absorbs water, liquefies, and crystallizes to ordinary mannite.

Though mannite is not fermentable under ordinary circumstances, it may be converted into fermentable sugar, by leaving it in contact under peculiar circumstances with animal tissues. (See *Am. Jour. Pharm.*, vol. xxix. p. 450.)

Tests for the Sugars and other Carbohydrates.

Under this head the several processes for testing the presence of sugar are introduced; they are particularly applicable to grape sugar and to the examination of urine. When urine has a high specific gravity, and other symptoms of diabetes appear, the physician finds it of the utmost importance to make a chemical examination. The pharmacist is very liable to be called on for this, and will find it an advantage to be supplied with a reliable urinometer (*see* Specific Gravity), a test rack and tubes, and the necessary chemical reagents.

Separation of pure sugar is usually difficult; free acids and bases must be avoided during the evaporation. The microscope furnishes the best criterion; the taste is no proof whatever.

Fermentation sets in directly on the addition of yeast (*see* Syllabus); sometimes treatment with dilute HSO_4 is advisable, but never necessary with urine; the amount of CO_2 evolved indicates the quantity of sugar. To rely on the formation of yeast cells may become deceptive through similar though different vegetations.

Polarized light would, to a certain extent, indicate the kind of sugar, but many substances have similar optical behavior.

Moore's Test.—Boiling with concentrated potash lye produces, with grape and milk sugar, a yellowish-brown and ultimately a deep brown color; with cane sugar only after its transformation into glucose. Supersaturating with an acid liberates a peculiar odor of burning sugar.

Heller's Test.—The urine is mixed with solution of caustic potassa, the mixture divided in two test-tubes of equal width, one of which is heated to boiling. The presence of sugar is indicated by a darker color, which is ascertained by comparison with the unheated liquid.

Lehmann's Test.—The solution of the saccharine matter in 90 per cent. alcohol yields, with a solution of KO,HO in absolute alcohol, a sticky or flocculent precipitate, readily soluble in water and reducing an alkaline solution of CuO.

Horsley's Test.—Five or six drops of diabetic urine produce a deep sap-green coloration in a boiling solution of chromate of potassium containing free alkali.

Knapp proposes a volumetric test solution: an alkaline solution of cyanide of mercury of known strength is heated to the boiling point; to this is added the sugar solution from a burette. The operation is known to be completed when a drop of the mixture is applied to a piece of the best Swedish filtering paper stretched over a beaker-glass containing sulphide of ammonium. A brown spot appears as long as the mercurial salt is present, and fresh addition of glucose is necessary.

Trommer's test is based on the reduction by grape sugar of oxide of copper to suboxide, in an alkaline solution, and is applied by mixing the urine or other saccharine liquid with some caustic potassa in a test-tube, and then adding a diluted solution of sulphate of copper, drop by drop, and with constant agitation, until the occasioned precipitate just commences to remain undissolved; the mixture is then raised to the boiling point, and if it contains grape sugar, deposits the orange-red hydrated suboxide of copper.

But many substances, like uric acid, some vegetable acids, hematoxylin, alkapton (*Proc. Am. Ph. Assoc.*, 1862, p. 173), reduce CuO under the same circumstances; kreatine, peptone, protein compounds, and some alkaloids interfere with the separation of the Cu_2O.

Fehling's Quantitative Test for Grape Sugar is an improvement on the method originally suggested by Barreswill. The test liquid is prepared by dissolving 40 grammes of crystallized sulphate of copper in 160 grammes of distilled water, and mixing this solution with 160 grammes of neutral tartrate of potassium dissolved in a little water; from 600 to 700 grammes of solution of caustic soda, specific gravity 1.12, are then added, and sufficient water to make the whole measure at 60° F. (15° C.) 1154.4 cubic centimetres. As one equivalent of glucose ($C_6H_{12}O_6$) reduces 10 equivalents of oxide of copper to suboxide, 1 litre of the above solution requires 5 grammes, or 10 cubic centimetres .05 gramme of grape sugar.

The saccharine solution is diluted until it contains not over 1 per cent. of grape sugar. 10 cubic centimetres of the test are diluted with 4 cubic centimetres of water, heated to boiling, and the saccharine liquid gradually added until it ceases to produce a red precipitate of suboxide of copper; the quantity of the liquid used contained .05 gramme of sugar. The quantity of sugar may like-

wise be calculated from the amount of suboxide of copper obtained, which is separated by filtration, well washed, and dried. 10 equivalents of protoxide (CuO) yield 5 equivalents of suboxide (Cu_2O); the weight of equivalent of the latter being 142.8, 5 equivalents weigh $142.8 \times 5 = 714$; the equivalent of grape sugar ($C_6H_{12}O_6$) weighs 180, and if we express the ascertained weight of suboxide of copper by s, the weight of grape sugar $= x$ is calculated by the following proportion—$714 : 180 = s : x$, or by adding one-half and $\frac{1}{175}$ part of the weight of the suboxide.

Fehling's test is not affected by pectin, tannin, or mucilage, but when several weeks old it is acted on by acetic, tartaric, oxalic, and the aromatic acids. In small well-corked vials, if protected from contact with the air, it keeps well for some time, but it is always safest to prepare it when wanted for use; the copper solution may be kept ready for mixing with a freshly prepared solution of the tartrate, and with the caustic soda, preserved in well-stoppered vials. Free uric acid reduces the test liquid, which fact must not be lost sight of in analysis of urine, which ought to be used quite fresh.

Cane sugar and starch cause no reaction with the test, but when they have been previously converted into grape or fruit sugar by a continued boiling with diluted sulphuric acid, the oxide of copper will be reduced, and from the ascertained quantity of grape sugar 95 per cent. indicates the weight of cane sugar ($C_6H_{12}O_6$), and 90 per cent. that of starch ($C_6H_{10}O_5$).

The test is likewise applicable to milk sugar, which reduces for each equivalent 7 equivalents of oxide of copper, so that 1 litre of the test liquid requires 7.143 grammes of sugar of milk for its reduction.

Boettger's Test.—A tablespoonful of urine and of sodium solution, containing one part of crystallized carbonate of sodium to three parts of water, is boiled with as much officinal nitrate of bismuth as will cover the point of a knife; glucose imparts a grayish or black color to the nitrate. Albumen is to be previously separated by coagulation; cane sugar and all organic substances usually present in urine are without action.

Mulder's Test.—Indigo is dissolved in strong sulphuric (better Nordhausen) acid, the liquid over-saturated with carbonate of potassium, to render it alkaline. This, when used, is sufficiently diluted to be of a light blue color, and boiled; if now a trace of grape or fruit sugar be added, the blue color is changed to green and purple; from a larger proportion of sugar, the color passes through red into yellow. If afterwards the liquid is shaken, the purple passes through green into blue, but the yellow through the above shades into green or greenish-blue. Cane sugar is not affected.

Vogel's test is the same as Mulder's, litmus being substituted for indigo.

Loewenthal's Test.—60 grms. tartaric acid, 240 grms. crystallized Na_2CO_3, 5 grms. crystallized Fe_2Cl_6, and 500 c.c.m. hot water yield

a solution remaining yellow on boiling, but turning brown with a trace of glucose and separating with a more voluminous precipitate.

Peligot's quantitative determination of cane sugar is based on the solution of lime in sugar; $C_{12}H_{22}O_{11}$ dissolve 3CaO, the quantity of which is determined by measure analysis with HSO_4. If glucose is present, a second assay is made with boiled solution of the saccharate; the grape sugar is destroyed by boiling, and the result indicates cane sugar; the difference between the second and first assay expresses the grape sugar.

Runge's Test.—Very dilute HSO_4, evaporated with the suspected solution by a water-bath to dryness, scarcely colors grape sugar; with cane sugar a black spot is produced; a similar spot also with starch and some other compounds.

Pettenkofer's Test.—Bile and concentrated HSO_4, produce, with sugar, a red color.

Maumene's.—Chlorine at a temperature at and above boiling water causes a brown color, deepening to black on drying. Carbohydrates, like lignin, hemp, linen, cotton, starch, etc., suffer a similar decomposition. A strip of white woollen, merino (which is not altered), is saturated with a solution of perchloride of tin and dried; a single drop of a saccharine or similar solution put on the strip, and heated over a lamp to a little above the boiling point of water, instantly effects a black stain. Even ten drops of diabetic urine in ten cubic centimetres of water produce a brownish-black color.

O. Schmidt's Test.—3PbO,$\bar{A}c$ and NH_3 produce, in solution of cane and grape sugar, white precipitates; on boiling the latter only changes the color to red.

Sugar in Urine.—It has been ascertained by Professor Brücke, and corroborated by Dr. Bence Jones, that grape sugar is a normal ingredient of urine, and it is, therefore, necessary to determine its quantity in disease; for this purpose Fehling's test is applicable, the inaccuracy of which arising from the presence of uric acid may be removed by precipitating the urine with oxalic acid or with $\frac{1}{25}$ of its measure of muriatic acid of 1.10 specific gravity, setting it aside for twenty-four hours in a cool place, after which time it contains but traces (.0001 p.) of uric acid.

Owing to the ammonia contained or readily formed in urine, which keeps some suboxide of copper in solution, Trommer's test does not show the small proportion of sugar in healthy urine, but it generally reacts with the urine of pregnant or nursing women. Minute quantities of sugar are not indicated by Boettger's test, if the black color of bismuth should be owing to the formation of sulphuret; a black coloration will, in this case, also be obtained by digesting the urine with levigated litharge. Heller's test is the most reliable for detecting very small proportions of sugar, but in a deeply-colored urine the changes produced by boiling may not be visible, and another experiment with Boettger's test be advisable.

Glucosides.—This term is applied to those organic principles which, by a peculiar decomposition, are resolved into grape sugar (glucose) and an altered or new principle. This change may be

effected: 1. By the action of mineral acids at a boiling temperature. 2. By heating the glucoside with alkaline solutions or baryta water. 3. By the action at mean temperatures of nitrogenized principles associated with the glucosides in the plants producing them, or otherwise; and 4. By yeast and saliva. Many of the vegetable acids and neutral principles described in this work might be classified as glucosides, but as this peculiarity in their chemical characters is less obvious and characteristic than others by which they are generally classified, it has not been thought best to form them into a distinct class, but by way of illustration and for convenient reference the following syllabus of some principles capable of this classification has been prepared.

Syllabus of some Glucosides.

Glucoside.	Process.	Product beside Glucose	Reaction.
Gallo-tannic acids	By acids†	Gallic acid	$C_{27}H_{22}O_{17}+4H_2O=3C_7H_6O_5+C_6H_{12}O_6$.
Arbutin	do.‡	Hydrokinone	$C_{12}H_{16}O_7+H_2O=C_6H_6O_2+C_6H_{12}O_6$.
Colocynthi	do.	Colocynthein	$C_{56}H_{24}O_{23}+H_2O=C_{44}H_{12}O_{12}+2C_6H_{12}O_6$.
Amygdalin	By emulsin and water	Oil of bitter almond & hydrocyanic acid	$C_{20}H_{27}NO_{11}+2H_2O=C_7H_6O+HCN+2C_6H_{12}O_6$.
Æsculin	By acids	Æsculetin	$C_{21}H_{24}O_{13}+3H_2O=C_9H_6O_4+2C_6H_{12}O_6$.
Convallarin	do.	Convallaretin	$2C_{24}H_{38}O_{11}+2H_2O=2C_{28}H_{26}O_6+2C_6H_{12}O_6$
Daphnin	do.	Daphnetin	$C_{21}H_{24}O_{13}+4H_2O=2C_6H_{12}O_6+C_{19}H_{18}O_{11}$.
Datiscin	do.	Datiscetin	$C_{42}H_{54}O_{24}=C_{30}H_{10}O_{12}+C_6H_{12}O_6$.
Digitalin*	do.	Digitaletin	$C_{27}H_{40}O_{15}+2H_2O=2C_6H_{12}O_6+C_{15}H_{20}O_5$.
Glycyrrhizin	do.	Glycyrretin	$C_{24}H_{36}O_9+H_2O=C_6H_{12}O_6+C_{18}H_{26}O_4$.
Helicin	Acids, emulsin, alkalies, or yeast	Salicylous acid	$C_{13}H_{16}O_7+H_2O=C_6H_{12}O_6+C_7H_6O_2$.
Jalapin	By acids	Jalapinal	$C_{31}H_{50}O_{16}+5H_2O=3C_6H_{12}O_6+C_{13}H_{24}O_3$.
Populin	do.	Benzoic acid, saliretin	$C_{13}H_{17}(C_7H_5O)O_7+H_2O=C_6H_{12}O_6+C_7H_6O_2+C_7H_6O$.
Salicin	By emulsin	Saligenin	$C_{13}H_{18}O_7+H_2O=C_6H_{12}O_6+C_7H_8O_2$.
Solania	By acids	Solanidin	$C_{43}H_{71}NO_{16}+3H_2O=3C_6H_{12}O_6+C_{25}H_{31}NO$
Thujin	do.	Thujetin	$2C_{20}H_{22}O_{12}+4H_2O=2C_6H_{12}O_6+C_{28}H_{28}O_{16}$
Xanthorhamnin	do.	Rhamnetin	$C_{23}H_{28}O_{14}+3H_2O=2C_6H_{12}O_6+C_{11}H_{10}O_5$.

Besides this class, in which glucose is a product, there are others in which peculiar sugars are formed, and others in which the decompositions are more complex, resulting in two or more new compounds; for descriptions of these and of the foregoing, the reader is referred to the principles themselves, as treated of under the several heads of organic neutral principles and acids; also to Gmelin's *Handbook of Chemistry*, Cav. Soc. Edit., vol. xv. p. 340.

Syllabus of the Saccharine Group of Medicines.

Names and origin.	Properties and uses.
Saccharum, sugar; from Saccharum officinarum.	Expectorant and laxative; in the form of powder and syrup; mostly as a vehicle and corrective.
Theriaca, treacle, molasses; the concentrated uncrystallizable juice of Saccharum officinarum.	A tenacious excipient for pills, may be purified by solution in alcohol and digesting with animal charcoal.

*Kosmann's. † Also by spontaneous fermentation. ‡ Also by contact with emulsin.

SYLLABUS OF THE SACCHARINE GROUP OF MEDICINES. (*Continued.*)

Names and origin.	Properties and uses.
Mel, honey; the liquid prepared by Apis mellifica.	Expectorant with more active medicines, combined with astringents in gargles; as an addition to poultices and as a vehicle; a factitious article is made from Havana sugar.
Saccharum lactis, lactin; from milk.	Used as a vehicle for powders, which are required in a very fine condition; has little taste and is very hard; recently used as food for feeding infants; less apt to produce acidity than cane sugar.
Glycyrrhiza, liquorice root; the rhizoma of Glycyrrhiza glabra.	Expectorant; in syrups, as a vehicle and corrective for unpleasant medicines; as constituent for pills.
Extractum glycyrrhizæ.	The liquorice ball is formed into sticks. (*See* Extracts.)
Manna; the concrete juice of Ornus Europæa.	Laxative. In syrups, mostly combined with senna and saline laxatives.
Mannitum, mannite; from manna.	Laxative in doses of ʒj to ʒij. Used as a vehicle and corrective.
Ficus, the fig; the fruit of Ficus carica.	Laxative. Used in confections. (Conf. sennæ.)
Prunum, prunes; the dried fruit of Prunus domestica.	Laxative. Used in confections. (Conf. sennæ.) In Europe as a popular vehicle for infusion of senna, to prevent griping.
Uva passa, raisins; the dried fruit of Vitis vinifera.	Laxative. Mostly as a corrective in a few tinctures, in gruel, etc.
Cassia fistula, purging cassia; the fruit.	Laxative. The pulp is employed as an ingredient in conf. sennæ.
Carotæ radix, wild carrot; the root of Daucus carota.	Diuretic and laxative, in the form of the expressed or inspissated juice; also as poultice.

Honey contains uncrystallizable fruit sugar and grape sugar; the latter is apt to be deposited, on standing, in a granular form; a volatile odorous principle and a little wax are generally present. For medicinal use, it requires clarifying. This is accomplished by heating it in a suitable vessel to a very moderate degree, and maintaining the temperature till it ceases to separate a scum, which is to be skimmed off as it rises to the surface.

Mel despumatum is also prepared by adding to honey an equal bulk of water and a little tannin, which, on being precipitated by lime-water carefully added, carries down with it the impurities; it is then to be evaporated to its original weight, the scum being carefully removed.

CHAPTER III.

ON ALBUMINOUS AND SIMILAR PRINCIPLES, AND CERTAIN ANIMAL PRODUCTS.

ALL plants and animals contain, besides the ternary proximate principles consisting of C, H, and O, others in which N is associated with the three former elements. Mulder was the first to prove that these vegetable principles, so essential for the sustenance of animal life, are not materially different from those occurring in

the animal kingdom, and that they all yield, after treatment with water, alcohol, ether, dilute muriatic acid, and strong potassa solution—*protein*, which he ascertained has the composition $C_{36}H_{25}N_4O_{10}$. Liebig, Dumas, and Cahours calculate the formula $C_{48}H_{36}N_6O_{14}$. A more recent analysis by Luberkuhn gives its formula as $C_{72}H_{112}R_2N_{18}O_{22}S$, R denoting an atom of univalent metal. This radical, it was asserted, yields with S and P in various proportions those proximate principles which have received the name of *protein compounds.*

It has, however, been proved that protein is always a product of decomposition, differing from the original compound from which derived in other respects besides the absence of S and P; the relations of these bodies to each other has not been cleared up, though it seems probable that they are copulated compounds.

Few of the protein compounds occur naturally in an insoluble condition; they are mostly met with in aqueous solution from which they are readily separated in an insoluble form by aid of heat (coagulation). They are characterized by the following reactions:—

Alkalies dissolve them, separating all or a portion of sulphur; cold nitric acid colors them yellow, forming xanthoproteinic acid; concentrated muriatic acid in the presence of air produces a violet or blue color; iodine solution a yellow coloration; sugar and concentrated HSO_4 generate a bright red color, similar to the one produced with biliary acids; a similar color is also obtained by a solution of protonitrate of mercury containing nitrous acid (Millon's test). Their solutions in acetic acid are precipitated by neutral salts and by ferro- and ferricyanide of potassium. With the salts of many heavy metals, they form insoluble compounds, mostly containing the protein body, acid, and base; this explains the adaptation of albumen and the allied principles as antidotes in poisoning by corrosive sublimate, blue vitriol, and other salts.

Prolonged boiling with mineral acids or alkalies decomposes them into leucina, tyrosina, and various other products, which are also formed by their putrefaction. Chromic acid and binoxide of manganium with HSO_4 evolve volatile acids of the composition $C_nH_nO_4$, hydrocyanic and benzoic acids.

Protein compounds in a putrefying condition act as ferments to many organic compounds, and on that account their removal by coagulation or precipitation with alcohol is provided for in many permanent pharmaceutical preparations.

Protein has been prescribed by physicians as a nutritive tonic and in the treatment of *impetigo capitis.* Dose, for young children 5 grains three times a day. As it is a subject of controversy by chemists, the remedy may be called—

Pure Insoluble Albumen.—Mix white of egg with its own bulk of water, filter and evaporate at 104° F. to the original bulk, then add a concentrated solution of caustic potash; the whole soon forms a translucid, yellowish, elastic mass; this is to be broken up, exhausted by cold water, avoiding exposure to the air, then dissolve it in boiling water or boiling alcohol, and precipitate the albumen by acetic acid or phosphoric acid.

The largest supply of albumen is from the blood of animals. In Pesth and North Germany it is used as a mordant for dyeing yarns and cloth. The serum which separates when the blood coagulates is largely albuminous· 3000 pounds of blood yield about 110 pounds of albumen.

Syllabus of the Protein Compounds.

Name.	Source.	Description, etc.
Albumen	In eggs, blood, chyle, pus, and other excretions and secretions, and in the juices of plants.	Coagulates between 130° & 170°F.; rendered uncoagulable by evaporation in direct sunlight, but when evaporated in diffused daylight is soluble; if it has become uncoagulable, it may be restored to solubility by small quantities of acetic, tartaric, citric, or formic acids; precipitates most of the salts of the earths and heavy metals (antidote to corrosive sublimate, etc.). Turns polarized light to left; contains from .7 to 1.7 per cent. S.
Casein	In milk; probably also in some other animal secretions.	Coagulates in the form of a skin upon the surface of its solution, by acids and by rennet in flocks; precipitated by $MgSO_4$ and CaCl. Contains .8 to 1 per cent. S.
Legumin or vegetable casein	In the seeds of Leguminosæ and in oily seeds.	Coagulates on evaporation in films, in behavior almost identical with animal casein.
Crystallin	In the lens of the eye.	Precipitated by CO_2, not by rennet; coagulates not below 195°; the filtrate from it is acid; readily reduced to an impalpable powder; resembles in many respects the globulin of blood.
Hæmoglobulin	In the blood-corpuscles.	Known only in combination with *hæmatin;* soluble in aqueous ether; coagulates at about 760°; forms by the influence of light and air *hæma-crystallin*, colorless or red crystals, which are not precipitated by $HgClAgNO_3$ or $2Pb,\overline{Ac}$.
Fibrin	In the plasma of blood, sometimes in exudations.	Coagulates spontaneously in the air: contains 1.2 per cent. S and some Fe; the coagulation retarded by KNO_3 and salts of the alkaline earths; promoted by beating; forms while putrefying soluble albumen.
Syntonin	In the fibrilles of muscles.	Coagulates spontaneously in the air; becomes gelatinous and dissolves in water containing $\frac{1}{1000}$ HCl. Muscles contain various protein compounds coagulating at different temperatures.

SYLLABUS OF THE PROTEIN COMPOUNDS. (*Continued.*)

Name.	Source.	Description, etc.
Emulsin, s. synaptas	In almonds and other seeds	Not precipitated by $\overline{Ac}$, precipitated by alcohol; decomposes amygdalin into HCy, etc.; loses this property by heat, but not when heated in the dry state to 212°.
Myrosin	In white and black mustard.	Decomposes myronic acid into oil of mustard and sugar; loses this property by heat and strong alcohol.
Aleuron	In the albumen of nutmeg and other seeds.	Crystalline; more or less soluble in water, acids, alkalies, glycerine, and syrup.
Vitellin	In the yelk of birds' eggs.	Resembles fibrin, but does not decompose HO_2.
Ichthidin, Ichthulin, Ichthin, and Emydin	In the eggs of fishes and amphibii.	Crystalline or granular.
Glutin	In wheat, rye, and other cereals.	Left on washing wheat flour with water to remove starch; consists of three or four compounds; the nourishing part of flour.
Zymome, s. coagulated vegetable albumen	The residue of crude gluten after boiling with alcohol.	Soluble in alkalies, in HPO_3, and $\overline{Ac}$; after heating to 212°, insoluble in NH_3; softens with water.
Gliadin	The portion of gluten soluble in boiling alcohol and precipitated by water.	Soluble in acids and alkalies; causes the formation of dough, on kneading flour with water.
Mucin (see page 352)	In the mother-liquor of gliadin.	Soluble in water, not precipitated by $HgCl_2$ and lead salts; insoluble in acetic acid.

Tests.—The physician has frequent occasion in the examination of urine to search for albumen and mucus (which is modified albumen), among the abnormal constituents of that secretion.

To test urine for albumen, it should be slowly heated in a test-tube to boiling. Unless the urine is very alkaline it will coagulate and separate in flakes. The precipitate may consist of phosphates, which will readily dissolve in a little nitric acid, though if the acid is added in excess, it will, after dissolving the phosphates, throw down albumen if present.

If a precipitate is produced by nitric acid and none by boiling, an excess of uric acid is probably present. If the urine was alkaline, this precipitate may be albumen, as an excess of alkali prevents its precipitation by heat. To confirm this test it is recommended to wash this precipitate and dissolve it in a little potash solution, then on the addition of a drop or two of the cupropotassic tartrate a rich violet color is obtained, unless the solution is too dilute.

For the estimation of albumen, Boedeker measures its solution

in acetic acid with an aqueous solution of 1.309 grm. ferrocyanide of potassium in 1000 c.c.; each c.c. precipitates .01 grm. albumen.

Besides the bodies enumerated in the above syllabus, there are many protein compounds found in various healthy and morbid secretions, which are as yet little known, and may probably be modifications of some above enumerated. Though they are of little interest to the pharmacist, we append a syllabus of the most important.

Modified Albuminous Principles.

Name.	Source.	Description, etc.
Para-albumen (of Scherer)	In the liquid of dropsical ovaries.	Scarcely turbid on boiling; by $\overline{Ac}$ and heat, floccules which cannot be filtered clear; the precipitate by alcohol soluble in water.
Meta-albumen	In dropsical liquids.	The solution in $\overline{Ac}$ not precipitated by KCfo; precip. by HCl, not by $\overline{Ac}$.
Pancreatin	In the pancreatic liquid.	Coagulates at 162°, by HSO_4 and HNO_3, not by HCl, $\overline{Ac}$, or HPO_3; alcoholic precipitate soluble in water; used of late years in treatment of disease.
Mucin (see p. 351)	In the secretion of the mucous membranes.	Not precipitated by heat, KCfo, $HgCl_2$, or tannin; precip. by alcohol, soluble in water, by $\overline{Ac}$ insol. in excess.
Pyin	In pus.	No precipitate by heat; precipitated by $\overline{Ac}$, alcohol, $Pb\overline{OAc}$, and $HgCl_2$.

Animal Products used in Medicine containing Protein Compounds.

Name.	Source.	Description, etc.
Ovum, egg	Phasianus galli.	Consists of *ovi testa* (90 to 96 per cent. $CaCO_3$), now rarely if ever used in medicine; *ovi albumen* (about 85 H_2O, 12 albumen, sugar, carbonates), used for clarifying syrups, etc., and for emulsionizing; *ovi vitellus* (about 16 vitellin, 30 fat with color, 52 Aq, 1½ ashes), used for emulsionizing oils and oleoresins.
Lac vaccinum, cow's milk	Bos taurus.	Contains 4 casein, 3.5 fat, 5.25 milk sugar, .7 salts, 87 Aq; used as a dietetic, rarely as a vehicle for medicines.
Serum lactis, whey	From milk by boiling with .1 per cent. alum, $\overline{T}$, wine, etc., and straining.	Contains the sugar, salts, and water of milk; used as a dietetic in certain diseases, and as a vehicle.

ANIMAL PRODUCTS USED IN MEDICINE CONTAINING PROTEIN COMPOUNDS. (*Continued.*)

Name.	Source.	Description, etc.
Butyrum, butter	The fat of cow's milk.	Used in ointments as an elegant substitute for lard; ung. hydrarg. oxidi and ung. hydrarg. nitr. made with butter, keep very well. (See *Amer. Journ. Pharm.*, xxx. 103.)
Caro, meat	The flesh of various animals.	Contains kreatina, kreatinina, sarkina, inosit, organic salts, chlorides, phosphates, extractive albumen, syntonin, fibres, 72 to 80 per cent. water.

GENERAL OBSERVATIONS.

Eggs.—When used for the clarification of syrups, etc., in pharmacy, the albumen of eggs must be dissolved in the cold liquid, which is to be gradually heated to the boiling point. The coagulum incloses mechanically the impurities suspended in the liquid.

The yelk is preferred for emulsionizing oleoresinous and volatile oils; for this purpose it is much better adapted than the albumen or gum Arabic, owing to its containing a considerable portion of a fat oil in which the volatile oils are soluble.

The *shell* or *testa*, powdered and levigated, is considered more acceptable to delicate stomachs than other forms of carbonate of lime, being very intimately mixed with a small proportion of organic matter.

Eggs are often desired by the sick and convalescent, and are sometimes allowable; there are one or two forms of acute disease in which they may be used with advantage. In cholera infantum, the stomach being irritable and the digestive process exceedingly imperfect, the yelk of an egg that has been boiled till it is dry (fifteen minutes or more), and reduced to a fine powder, may be appropriated by the infant in divided portions, without aggravating the intestinal irritation. In cases of dysentery of a low type, which frequently occur in malarial districts, where the patient is visited with fearful prostration, and the demand for support is imperative, and the stomach rejects the ordinary nutriment, the cessation of vomiting and nausea may often be brought about by the administration of the yelk of an uncooked egg taken in an unbroken state from the shell, or from a wineglass containing a little iced water or brandy and water.

No animal product is more universally employed in domestic economy and in the preparation of articles of diet for the sick; perhaps none is more really useful except milk.

Oil of Eggs.—Under this name a preparation is prescribed in some parts of England, and on the continent of Europe, as an emollient for sore nipples and excoriations, and it is sometimes called

for in this country. It may be prepared by gently heating yelks of eggs until they coagulate and the moisture evaporates; then breaking into fragments, digesting in boiling alcohol, filtering while hot, and evaporating. The *Paris Codex* directs the yelks to be exhausted with ether. A dozen eggs yield about an ounce. This oil contains sulphur, and was formerly used to "cut" mercury.

Milk is the natural and invariable food of the *mammalia* during infancy, and its properties adapt it perfectly to this use, besides fitting it for innumerable dietetic applications. It is one of the disadvantages of residing in large cities that this indispensable article is often furnished in a diluted state or of inferior quality.

By examination under the microscope, the oily ingredient, in exceedingly minute globules, is seen floating in the serous-looking white fluid; being lighter than the liquor in which they are suspended, a portion of these rise to the surface by standing, carrying with them some casein, and forming *cream*.

The quantity of cream ordinarily varies from 5 to 22 per cent. by measure, though, as obtained from certain very superior cows, the proportion is much greater. The milk from which cream is separated is called *skim-milk*.

Buttermilk approaches skim-milk in composition, but contains even less of the fatty globules. Dr. Gloninger, of Philadelphia, informs me that he has found it a valuable corrective of nausea, in the case of drunkards; Dr. Wm. Ashmead also uses it in the treatment of dysentery. Its use as an application to "sunburn" is well known to country people.

Curds and whey are made up of all the elements of milk, but the form in which they exist is changed by the addition of the rennet; the curd contains most of the fatty globules, while the whey consists of the sugar of milk and salts in solution. Whey is sometimes used with success as a diet for young infants whose digestion is impaired so that they cannot bear any of the ordinary forms of milk diet. Mixed with wine it is also a grateful diet for adults in low forms of disease. (*See* Appendix.)

Cream cheese consists of the moist curd which has been deprived of the greater portion of the whey by pressure.

Ordinary cheese, which contains little or much of the oily ingredient of milk, according as it contains the cream or is made from skim-milk, is made by precipitating the curd, and subjecting it to great pressure.

The *lactometer* is an apparatus for finding the specific gravity of milk, which, although it varies from 1.008 to 1.031, should reach nearly 1.030. Skim-milk is heavier, so that it will bear dilution with a little water to bring it to the normal specific gravity. The absence of the cream is, however, so easily detected by the blue tinge of color, and want of the characteristic rich taste, that this variation in the instrument is of little account. The specific gravity is not usually marked on the instrument, but the degrees of dilution instead, which, of course, are only approximative. The

microscope forms the best test for the purity and richness of milk, showing the proportion of the oil-globules.

Full directions for the quantitative analysis of milk, and tables of its relative richness as modified by circumstances, will be found in Dr. Hassell's work on *Adulterations in Food and Medicine.*

Solidified milk may be prepared by adding to 112 lbs. of fresh milk 28 lbs. of white sugar, and a half ounce of bicarbonate of sodium, and evaporating on a water-bath at a temperature much below boiling. The arrangements for stirring must be such as to prevent too much agitation, which would churn the cream into butter. A current of air should be established over the surface of the evaporating pans.

Solidified milk is extensively introduced into commerce in tablets, and put up in tin boxes, in a granular condition. It dissolves with facility in warm water; the milk produced from it is quite superior to much that is met with on shipboard and elsewhere, and is found to be an exceedingly useful article, especially for infants disordered by ordinary milk, or, from other causes, requiring to be weaned.

Analysis of 5 specimens of condensed milk, by L. Kofler, are given on page 457, vol. 42, *American Journal of Pharmacy*, by which it appears to be a very reliable preparation, yielding the full average of cream.

One pound will make three quarts of rich pure milk. For tea, coffee, or chocolate, it can be put upon the table and used as sugar but should be allowed to dissolve in the cup a moment before being stirred, as the cream globules will then remain unbroken. For young children, a tablespoonful dissolved in a teacupful of water is sufficient.

Oil of butter is the name given to a good emollient, perhaps slightly astringent preparation, well adapted to treating the summer complaint of children. It furnishes a suitable vehicle for the small doses of calomel, or mercury with chalk, and opium, so much prescribed in that complaint. It is made by warming butter floating on water, and when it is fluid skimming it off for use.

Meat.—The domestic uses of meat and its application for nourishment are well known; by long-continued boiling in water all its soluble constituents will dissolve, leaving behind only the fibre and a small quantity of earthy phosphates.

Liebig's Broth.—Liebig has recommended a broth for convalescents, which is prepared by chopping ½ lb. of beef, mixing it well with ½ drachm table salt, 4 drops muriatic acid, and 18 oz. distilled water, macerating for one hour, and straining through a fine hair sieve without expression. Dose, a teacupful. It contains all the soluble constituents of meat together with the hæmatin; the muriatic acid aids in digestion. This preparation is rendered more palatable and is found to agree with the stomach better if filtered, its appearance is also much improved.

Extractum carnis, preserved juice of meat, may be made by subjecting beef in iron cylinders heated by steam to a temperature of 220° for about three hours; on cooling, the small amount of juice ob-

tained solidifies, and may be freed from fat. This is introduced into small tin cans, which are heated till the air is expelled, and then soldered to exclude the atmosphere. By the addition of 4 parts of boiling water this will make a strong beef-tea. The various manufacturers of this and similar preparations have modified processes for extracting and preserving the soluble parts of beef, each claiming superiority for his own, some preferring liquid and others the solid form. Hager recommends that extract of beef should be regarded as below standard if it contains more than 22 per cent. of moisture, and over 27 per cent. of matter insoluble in alcohol .833 sp. gr. Gallotannic acid should not precipitate more than 20 per cent. of its weight, and should not yield more than 8 per cent. argentic chloride.

Kreatin is the name applied to those principles which form the chief part of the cell walls of horn and epithelium. They contain about 50 per cent. C, nearly 17 per cent. N, and 5 per cent. S (in hair); by continued boiling with dilute sulphuric acid, leucina and tyrosina are formed; concentrated muriatic acid produces gradually a violet color, nitric acid a yellow, and sugar with sulphuric acid a red color. Caustic alkalies render the cells more distinct.

Horn is not now used in pharmacy, except for preparing some utensils, scale dishes, spatulas, spoons, and scoops, which are adapted to cases where metal would be corroded.

Gelatinous Principles.

Two varieties have been distinguished: one occurring in bone and animal membranes, epidermis, fish bladders, etc., called *collagen* or *osseine*, which yields on prolonged boiling with water gelatine or common glue; it is not precipitated by alum, sulphate of aluminium, ferric chloride, trisacetate of lead, or protonitrate of mercury; gelatinizing in the presence of alum is prevented by acetic and other acids; the addition of nitric acid keeps the solution in a liquid form; the so-called *liquid glue* is made in this manner. It is a test for tannin, with which it produces an insoluble precipitate.

The other kind, *chondrogen*, is contained in permanent cartilage, and yields by continued boiling with water *chondrin*, a glue, which is precipitated by the above-named salts.

The purest natural form of collagen is *isinglass*, which is found in commerce, prepared from the swimming bladder of the sturgeon and other fish. Gelatine is the basis of a variety of artificial preparations used as food.

The solubility of glue in glycerine is deserving attention as a means of suspending remedies of an unpleasant character; while in analysis, a solution in glycerine would be permanently kept in good condition as a quantitative test for tannic acid. (*See* paper of Prof. J. M. Maisch in *Am. Jour. Phar.*, vol. 42, fol. 518.)

Ichthyocolla. (*Isinglass.*)—Numerous articles are met with in our markets under this name. One of the cheapest is that called *fish glue*, used almost exclusively for clearing coffee, as a substitute for

white of egg; this, I believe, is identical with the New England isinglass described as being prepared from the air-bladder of the common hake (*Gadus merluccius*), which, being macerated in water a little while, is then taken out and passed between rollers, by which it is pressed into thin ribbons of several feet long, from an inch and a half to three inches in width. It is an inferior variety, unfit for internal use. (*See* Report by C. T. Carney, *Proceedings Am. Pharm. Assoc.*, 1857.)

Russian Isinglass is met with principally in the form of sheets, or folded into compact and twisted forms, called staples. Sometimes it is in fine shreds. In sheets and shreds it is esteemed the best, but is very expensive, and on that account mostly superseded by the articles next to be described.

Cooper's Gelatine comes in sheets 9 inches long, and 3½ wide, and about ⅛ inch thick, in a very light opaque form, nearly white color, and marked with the nets on which they have been dried; sometimes these are cut up into small pieces.

French Gelatine is in cakes which are rather smaller, very thin, and quite transparent, similarly marked by the drying nets; sometimes it is imported in shreds, put up in boxes with directions for use. It is readily clarified, and makes a good jelly. Sometimes the French is colored red.

Coxe's Sparkling Gelatine is a superior article, put up in packages, and extensively introduced throughout the United States.

In the preparation of jellies from Cooper's or the French variety, the soaking of the gelatine previous to making the jelly is made necessary by the slight taste they acquire at the surface or point of contact with the air and moisture. It should be soaked at least an hour in cold water, which should then be thrown away, and the gelatine, after draining a little, is fit for use.

Calves' feet are still in request by many who believe gelatine, as manufactured from ordinary animal tissues, to be altogether inferior. The *extract of calves' feet*, prepared by John Mackay, of Edinburgh, though not, when first dissolved, furnishing so clear a jelly as some others, is, when clarified by white of egg, exceedingly brilliant, and possesses a peculiar softness and richness upon the palate, which connoisseurs recognize as that of the true calves' feet jelly.

Court Plaster and Isinglass Plaster.

This popular and useful plaster has the merit of neatness and facility of application, adhering readily on the application of moisture. By some manufacturers it is made by coating sheets of silk or other fine material with a solution of New England isinglass (fish glue); by others the finest Russian isinglass is applied, and the choice of a superior quality of silk, and the application to it of a balsamic varnish to render the unspread surface impervious to moisture, insures a better plaster.

The original Liston's isinglass plaster, or gum-cloth, was made by spreading several coats of strong solution of isinglass in very

dilute alcohol over the surface of animal membrane, previously prepared for the purpose from the peritoneal membrane of the cæcum of the ox.

The following is an approved recipe for isinglass plaster:—

Take of Isinglass	℥j.
Water	f℥viij.

Dissolve with heat—

Benzoin	ʒij.
Alcohol	f℥ij.

Dissolve, strain, and mix the two solutions together, and, with a brush, apply several coats of this mixture, while it is kept fluid by a gentle heat to silk stretched on a frame; each successive coat being allowed to dry before applying the next. Then paint a layer of the following solution on the other side of the silk:—

Venice turpentine	℥j.
Tincture of benzoin	f℥ij.

Mix.

Black and flesh-colored silk are both used for court-plaster.

Os, U. S. P. (*Bone*).—Bones are officinal for their uses in the preparation of bone phosphate of calcium, and the phosphates of sodium and ammonium; they are also used in preparing animal charcoal. Bones consist of gelatinous tissue, into which earthy and saline matters have been deposited until they have acquired solidity and firmness. By soaking in muriatic acid, the phosphate and carbonate of calcium are dissolved, and the osseine is left as a tough, flexible, nearly transparent mass, having nearly the same form as the bone.

Fel (*Bile*).—This is a yellow-greenish, viscid, oily liquid, with a bitter taste, followed by a sweetish after-taste, which is separated from the blood of animals by the liver, and collected in the gall-bladder. It is entirely miscible with water, and its solution froths like one of soap. Its composition varies with different animals, but it consists mainly of two salts of sodium in which that base is combined with two remarkable nitrogenized substances, choleic and cholic acids; another constituent is a peculiar crystallizable fatty substance called cholesterin. With nitric acid it shows a peculiar polychrome, depending on its coloring matters; sugar and sulphuric acid produce a red color the result of a reaction with the biliary acids and their derivatives.

Inspissated ox-gall (*Fel bovinum*) is occasionally prescribed in dyspeptic affections connected with habitual costiveness. It is prepared for use by being heated and strained, and then evaporated in a water-bath, or by well-managed radiated heat, to a pilular consistence. The dose, when thus inspissated, is from five to ten grains.

Ox-gall is also much used as a detergent, and in a refined or clarified condition is adapted to the use of landscape painters as a delicate green pigment.

Sodii Choleinas—Choleinate of Sodium—has been used, though a preparation which has no claim to being a pure chemical salt; the

mode of preparing it from animal gall is as follows: The fresh ox-gall is evaporated to one-half, slimy and coloring matters are precipitated by an equal bulk of alcohol, the filtrate is treated with animal charcoal, the alcohol distilled off, and the residue washed with ether. The choleinate of soda then remains behind as a white, somewhat sticky mass, of a penetrating odor, and a peculiar, sweetish, afterwards bitter taste; it is easily soluble in water, and dissolves albumen and casein.

Being a natural constituent of bile, it has been employed with success in affections where a tonic with particular tendency to the biliary organ is desired. The dose is from 5 to 15 grains, two to four times a day.

Pepsin.

Pepsin is the name given to a neutral principle obtained from the gastric juice of animals, and which, associated with lactic and muriatic acids, has the property of digesting certain kinds of food. As it would be impossible to collect the gastric juice from living animals for the purpose of extracting the pepsin for use in medicine, recourse is had to the little tubes upon the inner surface of the stomach, in which it is secreted. Some of the processes apply to the lining membrane of the stomach of calves and sheep, others to the porous parts of the stomach of the hog, an omniverous animal approaching nearer to man in the digestive function. Freed from the glandulous membrane, these are cut, and repeatedly macerated with water for twenty-four hours. The older processes directed that the filtered liquids be precipitated by sugar of lead, the precipitate washed with water, decomposed by sulphuretted hydrogen, filtered, evaporated by a very gentle heat to a syrupy consistence, and mixed with alcohol; pepsin is slowly precipitated as a white voluminous mass, which is washed with alcohol and dried.

At the date of the third edition of this work, the American market was chiefly supplied with pepsin from abroad; but when the value of the remedy began to be recognized, the ingenuity of American pharmacists was exerted in perfecting processes for its production.

Of several modified processes which have from time to time been published, that of Mr. Wittich, originally published in *Pfluger's Archives*, consisted in macerating the bruised and minced mucous membranes in concentrated glycerine; after twenty-four hours it was acidulated, and found to be capable of digesting fibrine rapidly. Pepsin was separable from this on dilution, filtration, and the addition of alcohol. Dr. L. S. Beale, as long ago as 1858, described, in *Archives de Médecine*, a process which consisted of quickly drying on plates of glass the mucus expressed from the stomach glands, powdering the dried mass, and preserving it in stoppered vials; of this, eight-tenths of a grain are said to dissolve one hundred grains of coagulated albumen.

From this powder an easily filtered solution of great activity can be prepared. Dr. Beale uses a portion of this solution with gly-

cerine in preparing tissues for dissection and examination under the microscope.

To Emil Scheffer, of Louisville, Kentucky, belongs the credit of having solved the problem of an economical and effective process for the preparation of pepsin, both in the form of powder and in that of liquid, and the articles now manufactured by him are justly esteemed as meeting the demand for an artificial aid to the digestive process. In several papers in the *Am. Journ. Phar.*, vol. xlii. 98, vol. xliii., and vol. xl., he gives the results of numerous experiments on the preparation and properties of pepsin. The best method of separating it from the extraneous matters with which it is associated affords a product nearly free from impurities, and possessing the solvent powers of the natural gastric juice. This process depends upon the insolubility of pepsin in saturated solution of common salt. The mucous membrane of the hog's stomach is dissected off, chopped finely, and macerated for several days with frequent stirring in water acidulated with muriatic acid; the liquid is then separated from the stomach and set aside for ten to twelve hours, until the mucus has settled; common salt (chloride of sodium) is then added until the liquid is saturated. After standing a short time, the pepsin separates and floats on the surface; this can be readily removed with a spoon, and should then be placed on a paper filter to drain. Finally, it is submitted to strong pressure, to free it, as far as possible, from the salt solution. When removed from the press and dried spontaneously, this pepsin is a tough substance, resembling parchment paper, varying from a dim straw-yellow to a brownish-yellow color.

For dispensing, the pepsin, fresh from the press, is triturated to powder with a weighed quantity of sugar of milk (lactin). This powder is reweighed after having been air-dried, and the amount of pepsin it contains is found by deducting the weight of the lactin employed. Finally, the powder is tested by ascertaining how much coagulated albumen it will dissolve at a temperature of 100° F. in from five to six hours; sufficient sugar of milk is then added to result in a preparation of such a strength, that 10 grains, dissolved in 1 fluidounce of water with 6 drops of muriatic acid, will dissolve 120 grains coagulated albumen at a temperature of 100° F.

Recently precipitated pepsin, as prepared by the above process, is very soluble in water; when dried, however, and put into water it swells like glue, but dissolves only slowly and in small quantities. The aqueous solution has a nearly neutral reaction, is coagulated by boiling, and precipitated by alcohol, tannin, bichloride of mercury, and salts of lead and copper. It has little action on coagulated albumen, but the addition of a little muriatic acid develops its solvent powers and renders it soluble. The digestive power of the solution seems to be greatest when it contains about 6 drops of acid (sp. gr. 1.17) to the fluidounce; a larger proportion increases the time required to effect the solution of the albumen. According to Scheffer, 1 grain of purified pepsin in 4 ounces of acidulated water dissolves 500 grains of coagulated albumen at a temperature of 105° F.

in six hours. At a temperature of 75° only 400 grains are dissolved after eighteen hours. If the amount of pepsin is increased, the time of solution is not proportionately diminished, but the pepsin seems to communicate its digestive power to the dissolved albumen (peptone or albumenose), so that practically its solvent action is almost unlimited. If, for example, 500 grains of coagulated albumen are dissolved in 4 fluidounces of water acidulated by the aid of a minimum quantity of pepsin, and an equal volume of acidulated water is added, a digestive fluid is produced, quite as energetic as the first. By adding to this solution an equal volume of saturated salt solution, we shall obtain a copious white separate, which dissolves in water, forming a solution not coagulated by heat, but precipitated by alcohol slowly, and by bichloride of mercury and chloride of sodium. The solution in water has a slight acid reaction, but does not act on coagulated albumen. On adding a few drops of hydrochloric acid, however, it manifests digestive powers similar to pepsin itself. In one experiment, half a grain of pepsin dissolved 240 grains of coagulated albumen; the solution yielded on the addition of chloride of sodium a precipitate, which weighed when dry 12 grains. This peptone precipitate was found capable of dissolving 1200 grains of coagulated albumen; the solution yielded 120 grains peptone precipitate, 1 grain of which was capable of dissolving further about 25 grains coagulated albumen. Pepsin as prepared by Scheffer contains a small proportion of chloride of sodium. When freed from this, it loses to a very considerable extent its solvent powers. The addition, however, of a larger quantity of salt does not seem to promote its activity; on the contrary, if the amount exceeds 5 grains to the ounce, its digestive action is decidedly retarded. Alcohol in all proportions diminishes the solvent power of pepsin. If the amount is greater than 20 per cent. of the fluid, the albumen is scarcely at all acted upon, but acquires the peculiar sour odor which characterizes discharges from a stomach overloaded with beer or wine.

A small quantity of carbonate of soda will precipitate pepsin from its solution unchanged; a larger quantity redissolves the precipitate, but so modifies it that it no longer possesses digestive powers. The alkaline solution becomes putrid, and acts on coagulated albumen only after putrefaction sets in with development of a genuine fecal odor. The alkaline solution, however, will act on partially digested albumen.

In regard to its stability, the experiments of Scheffer go to show that all watery solutions of pepsin undergo changes which in a short time render them inert. Even strongly acidulated solutions, although they did not undergo putrefaction, became in a few weeks inactive and were no longer precipitated by chloride of sodium. Liquid pepsin prepared with glycerine retains its efficiency for a longer period. The precipitated pepsin, when kept in a moist state or mixed with sugar of milk as in saccharated pepsin, seems to retain its properties perfectly, specimens examined after twelve months proving to have lost nothing of their strength.

CHAPTER IV.

FERMENTATION, ALCOHOLS AND ETHERS.

Fermentation is the process, whether spontaneous or artificially induced, by which the ternary compounds considered in Chapter II. are decomposed, and resolved into more stable and unorganized forms. It has been stated, in describing these, that under the influence of diastase, a peculiar principle found in germinating seeds and buds, the insoluble principle, starch, becomes converted into the more soluble dextrin and grape sugar; also that, under the influence of chemical agents, a similar change may be made to take place in cane sugar and in lignin.

Associated with these ternary principles, we find constantly in plants nitrogenized or quaternary principles treated of in the last chapter, which, by favoring these changes, are continually tending to the production of grape or fruit sugar and to their further metamorphose into alcohol and carbonic acid.

The circumstances necessary to produce fermentation are, a solution containing starch or sugar, at a moderate elevation of temperature, say from 70° to 90° F., which, however, rises as the process proceeds; and a ferment, or nitrogenized principle itself in a state of decomposition. The juice of the apple furnishes one of the most familiar illustrations of the presence of these indispensable conditions. We have in that liquid the ternary compounds associated with vegetable albumen, a nitrogenized material capable of playing the part of a ferment, and at the season of the year when the juice is extracted, the requisite elevation of temperature. As a consequence, fermentation takes place. The vegetable albumen absorbs oxygen from the air, runs into decomposition, sets the whole of the starchy and saccharine constituents of the juice to fermenting, and they are converted into alcohol, which is present in the resulting cider, and carbonic acid, which is given off, producing the well-known frothing of the liquid.

In the production of wine, we have another instance of spontaneous fermentation—the expressed juice of the grape, set aside in large casks, undergoes spontaneously the necessary change; if the sugar is in excess, and the nitrogenized matter deficient, a sweet wine is produced; if these conditions are reversed, and the whole of the sugar is changed into alcohol, a dry wine results. If the wine is bottled before the alcohol has been produced in sufficient proportion to coagulate the albumen, the process goes on after it has been corked up, the carbonic acid is confined, and a sparkling wine results.

The composition of alcohol is expressed by the formula C_2H_6O, and its production by the decomposition of grape sugar is thus explained: one equivalent of grape sugar $= C_6H_{12}O_6$, is broken up into 2 of alcohol, C_2H_5HO, + 2 of carbonic acid, CO_2, thus—

$$\begin{aligned} 2\overset{C_2H_5O}{H} &= C_4H_{12}O_2 \\ 2CO_2 &= \underline{C_2 \quad O_4} \\ & \quad C_6H_{12}O_6 \end{aligned}$$

This breaking up of sugar into alcohol and carbonic acid is, however, never complete; a small portion of the sugar is, under these circumstances, always converted into glycerine, mannite, succinic, and other acids; fusel oil or amylic alcohol is likewise a product of fermentation, though the precise conditions under which these bodies are formed are unknown.

The *acetic* fermentation consists in the oxidation of alcohol by long exposure to the air in a very divided condition and the removal of a portion of the hydrogen, or in contact with ferments, as when cider is allowed to remain in open casks until it passes into vinegar. Under the head of *Aceta*, the preparation of vinegar for use as a menstruum in pharmacy is spoken of, as also its substitution by diluted acetic acid.

The *lactic* and *butyric* fermentations are produced in milk by the action of the nitrogenized principle, casein, upon sugar present in the whey. (*See also* Malic Acid.)

The *viscous* fermentation takes place in certain complex saccharine and mucilaginous mixtures by the action of ferments; its results are carbonic acid, hydrogen, alcohol, lactic acid, and mannite.

Fermentation is artificially produced in the process of manufacturing most of the spirituous liquors and beer; the insoluble yellowish viscid matter deposited from the infusion of malt in the process of making beer, called yeast, *Fermentum cerevisiæ*, is the best substance for producing the "catalytic" effect in starchy and saccharine solutions. Added to an infusion of rye and Indian corn, it produces, by fermentation, the so-called rye whiskey; to potatoes ground to pulp and mixed with hot water, potato spirits; to molasses, rum, etc. In each case a portion of malt is used to facilitate the process by furnishing diastase.

Malt is barley which has been steeped in water till much swollen and softened, and then piled in heaps, to undergo a species of fermentation, or rather germination, during which a portion of its starch has passed into sugar and become soluble, and the peculiar ferment before mentioned as diastase is produced; the seed is then kiln-dried, to destroy its vitality.

Malt liquors are obtained by subjecting malt to infusion with water, mixing this with a due proportion of hops, which give the taste and tonic properties, and subjecting to the requisite fermentation. Under the head of Medicated Wines, a recipe was given for wine of tar, or Jew's beer, a medicated, fermented liquor.

The so-called *neutral sweet spirit*, or neutral spirit, is whiskey, which has been diluted and rectified by passing through charcoal,

which abstracts from it the fusel oil; when redistilled it ranges from first to fourth proof in strength.

Holland gin is manufactured from malted barley, rye meal, and hops, and distilled from juniper berries, to which it owes its flavor. The Schiedam Schnapps, so extensively advertised, is stated to be Holland gin, of good quality, though an inferior article is also sold under that name. Arrack is the spirit from the fermentation of rice; it possesses a peculiar flavor, the origin of which has not been divulged.

The origin of alcohol and other spirituous liquors which have apparently no foreign odor, can be found out by agitation of about two fluidounces of the liquor with five grains of caustic potassa dissolved in a little water, and subsequently evaporating until about $1\frac{1}{2}$ to 2 fluidrachms remain, which residue is to be mixed with about seventy minims of dilute sulphuric acid, when the characteristic odor will be immediately diffused; the origin of the spirit obtained from grain is thus unmistakably discovered.

Table of the Proportion, by measure, of Alcohol, sp. gr. .825, contained in 100 parts of the Liquids named.

Wines.		Wines.	
Port (strongest)	25.83	Cincinnati	9.00
" (weakest)	19.00	Currant wine	20.55 (?)
Madeira (strongest)	24.42	Gooseberry wine	11.84
" (weakest)	19.24	Orange "	11.26
Sherry (strongest)	19.81	Elder "	8.79
" (weakest)	18.00	Cider (strong)	9.88
Teneriffe	19.79	" (weak)	5.21
Lisbon	18.94	Burton ale	8.88
Malaga	17.26	Edinburgh ale	6.20
Claret (strongest)	17.11	Brown stout	6.80
" (weakest)	12.91	London porter	4.20
Malmsey	16.40	Small beer	1.28
Sauterne	14.22	Brandy	55.39
Burgundy	14.57	Whiskey (Irish)	52.20
Hock	12.08	Rum	53.68
Champagne	12.61	Gin	51.78

These figures, which are compiled from the tables of Brande and others, are, of course, only approximative. They are believed to be generally too high.

Properties of Common or Ethylic Alcohol and its Derivatives.

Product.	Process.	Description, etc.
Alcohol, absolute alcohol, ethylic alcohol C_2H_6O	From the fermentation of sugars by distillation.	Sp. gr. .796; boiling point 172°F.; not solidifiable by cold; combines with water with condensation, burns with blue flame; chemically indifferent; replaces in some compounds water of crystallization; solvent for resins, volatile oils, most fats, sugars, alkaloids, organic acids, alkalies, their sulphides and cyanides, many salts, iodine, and some other elements.

Properties of Common or Ethylic Alcohol and its Derivatives.—Con.

Product.	Process.	Description, etc.
Ether, ethylic ether $C_4H_{10}O$	By the decomposition of alcohol by H_2SO_4, H_3AsO_4, H_3PO_4, $SbCl_3$, $SnCl_2$, $ZnCl$, etc., with the aid of heat.	Colorless liquid; odor penetrating; taste sweetish, burning; sp. gr. .712; boils at 95°; crystallizes at —48; very inflammable and volatile; dangerously explosive when mixed with O; soluble in 9 parts water; dissolves $\frac{1}{36}$ water; solvent for I, Br, P, and a few salts, all fats, volatile oils, many resins, alkaloids, etc.
Nitric ether $C_4H_{10}NO_3$	By distilling 250 grms. each of alcohol and HNO_5 sp. gr. 1.40, and 33 grms. urea.	Colorless liquid; odor pleasant; taste sweetish; boils at 185°; detonates violently at a higher heat; sp. gr. 1.112; burns with white flame; soluble in alcohol; nearly insoluble in water.
Nitrous ether, hyponitrous ether $C_4H_{10}NO_2$	By conducting gaseous NO_3 into alcohol: by distilling HNO_3 and alcohol with Cu or with FeCl.	Pale yellowish liquid; odor fruitlike and vinous; taste burning; poisonous when inhaled; sp.gr. .947; boiling point 57°.5; very inflammable; burns with white flame; soluble in alcohol; sparingly soluble in water; decomposes spontaneously.
Sulphovinic acid $C_2H_6SO_4$	From H_2SO_3 and alcohol at about 200°, and removing excess of H_2SO_3 by $BaCO_3$.	Clear oily liquid; strongly acid; soluble in alcohol and water, insoluble in ether; easily decomposed by heat into H_2SO_3 and ether when concentrated, or alcohol when dilute; salts soluble in alcohol and water.
Heavy oil of wine, s. oleum æthereum $C_2H_6SO_4+C_2H_5SO_4$	By distilling alcohol with much H_2SO_3; by the dry distillation of sulphovinates.	Yellowish oil; sp. gr. 1.13; boiling point 535°; odor penetrating; readily soluble in alcohol and ether; decomposed in contact with water into sulphuric acid and light oil of wine.
Light oil of wine C_2H_4	By the decomposition of heavy oil of wine with water or alkalies.	Colorless oil, lighter than water; decomposed spontaneously into *etherin*, long, tasteless, and inodorous needles, and *etherole*, pale yellowish oil; sp. gr. .921; persistent aromatic odor; both soluble in alcohol and ether.
Aldehyde, acetaldehyde C_2H_4O	By the oxidation of alcohol; by distilling dry formiate with acetate of lime.	Colorless liquid; odor ethereal; sp. gr. .79; boiling point 71°; inflammable; soluble in all proportions of water, alcohol, and ether.
Acetic acid $HC_2H_3O_2=HOC_2H_3O$	By the slow oxidation of alcohol and aldehyde.	*See* Products of Distillation of Wood.
Acetic ether $C_2H_5C_2H_3O_2$	By the distillation of an acetate with H_2SO_3 and alcohol, and separating by NaCl or $K_2\overline{Ac}$.	Colorless liquid; odor and taste fruit-like, penetrating; sp. gr. .91; boiling point 165°; very inflammable; soluble in alcohol and 7½ parts water. To detect alcohol in ether add to the suspected ether an equal bulk of glycerine in a test-tube, shake up well; any alcohol present will be seized upon by the glycerine and diminish the bulk of the ether under examination.

Medicinal Preparations from Alcohol and its Derivatives.

Alcohol fortius.	Sp. gr. .817. Used in the preparation of ether, collodion, certain tinctures, for "cutting" castor oil, etc.
Alcohol.	Sp. gr. .835. Used for preparing resinous and other tinctures, some extracts and fluid extracts.
Alcohol dilutum.	Sp. gr. .941. Used for preparing most tinctures, extracts, and some fluid extracts.
Amylicum.	Sp. gr. .818. Boils from 268° to 272°; used principally to prepare valerianic acid by means of oxidizing agents.
Æther.	Sp. gr. .750; sp. gr. of vapor 2.586. Colorless, volatile, highly refractive.
Æther fortior.	Sp. gr. not exceeding .728, used for preparing collodion and for some other purposes.
Oleum æthereum, oil of wine.	Used only for preparing Hoffmann's anodyne; its anodyne effects are similar or superior to those of ether.
Spiritus ætheris compositus, Hoffmann's anodyne.	Ether f℥viij, alcohol Oj, ethereal oil f℥vj; nearly colorless liquid; odor ethereal and aromatic; becomes milky with water.
Spiritus ætheris nitros, sweet spirit of nitre.	Colorless or yellowish liquid; odor fragrant, fruity, without pungency; boiling point 156° to 158°; sp. gr. .840 to .841; soluble in all proportions in water, alcohol, and ether.
Spiritus ætheris chloridi, s. *spiritus salis dulcis.*	From NaCl 8, MnO_2 3, H_2SO_4 6, and alcohol 24 parts; distil 21 p. Its composition is not definitely known. Colorless, neutral; odor sweetish, aromatic; becomes turbid with water. Used like similar compounds as refrigerant, diuretic, and diaphoretic.
Æther acetivus, s. *naphtha acetis.*	Used like the other ethers, chiefly in hysterical complaints. Dose, gtt. 10 to 15 and more.
Spiritus ætheris acetici.	Acetic ether 1 part, alcohol 3 parts. Colorless, neutral; odor, taste, and use of acetic ether, but milder.
Spiritus vini gallici.	Obtained by distilling the spirit from wines. Should contain from 48 to 56 per cent. alcohol.
Spiritus frumenti.	Obtained from distillation of fermented grain. Should contain from 48 to 56 per cent. alcohol.

Alcohol.

This useful solvent is obtained by distillation from whiskey (*Spiritus frumenti*, U. S. P.), which, as procured from the farmers, is generally the product of the distillation of fermented infusion of Indian corn (*Zea mays*), mixed with rye; the smallest proportion of the latter ingredient that answers well is one part to two of the corn. A "mash" may consist of 20 bushels of grain, viz. 14 Indian corn, 4 rye, 2 malt; 34 gallons of water are added to each bushel of grain; after dilution with water to cool, it contains 1 bushel in 50 gallons. The temperature for "mashing" varies from 158° to 190°. 50 gallons of the beer yield about 4 gallons of whiskey, sometimes, however, the yield is but 3½ gallons from each bushel of grain. Some distillers of alcohol make their own whiskey, while others buy it. In the western States, much of the whiskey is produced by the fermentation and distillation of the refuse from flour or grist-mills. The whiskey is inspected by an officer appointed by the State government, whose business it is to fix the value of every lot, by ascertaining the proportion of alcohol it contains.

The terms first, second, third, and fourth proof spirits, apply to the relative strength of specimens, according to arbitrary standards

fixed by law, but varying in the several States. The standard of the United States custom-houses is fixed by the tables of Prof. R. S. McCulloh, published by order of Congress, entitled *Report of the Computation of the Manual of Tables to be used with the Hydrometer*, and *The Manual for Inspectors of Spirits.*

The standard of *proof* is fifty per cent. by volume or measure of absolute alcohol, and fifty per cent. of water, sp. gr. .936. This is 15 per cent. weaker than London proof spirits. *Second proof* has 52½ per cent. alcohol, sp. gr. .931. *Third proof* is 55½ per cent. alcohol, sp. gr. .925. *Fourth proof*, 58 per cent. alcohol, sp. gr. .920; this is London proof.

The instrument used for testing the sp. gr. of spirits, sometimes called an alcoholometer, is a modification of the ordinary hydrometer made by Luhme & Co., and Greiner, of Berlin, and sold by importers of chemical apparatus. These have thermometers in the bulb to indicate the changes of temperature, and consequent variations in specific gravity.

Considerable uncertainty exists in stating the proportion of alcohol in spirits, owing to some tables being founded on the percentage by weight, and others the percentage by volume; the alcoholometers above referred to have scales indicating both.

The rectification of alcohol is accomplished in appropriate apparatus, consisting chiefly of large *stills*, some capable of taking a charge of 60 gallons. These are chiefly made of copper, and consist of the body and head, which are connected with a furnace, and the worm, which is inclosed in an appropriate refrigerating tub. The whiskey being turned into the body, and the apparatus closed, heat is applied; the vapor formed, passing into the cooler, is condensed and runs out at the lower end. The first and last portions that come over are collected separately from the rest as of inferior quality, and the main body of the distillate is transferred to barrels which have been charred on the inside, and constitutes commercial alcohol.

This, the most common variety in this country, is called *druggists' alcohol.* It varies with the care used in its preparation, and especially with the heat employed. Sometimes, by urging the process too rapidly with a hot fire, the alcohol has an odor of fusel oil, and is too weak; the former may be detected by its odor, which reminds of whiskey, and the latter, by its sp. gr., which exceeds the officinal standard .835. Sometimes it is discolored, from deficient charring of the cask in which it is kept.

Besides this quality, the common or old sort of *deodorized alcohol* is made. For preparing this, the whiskey is submitted to extensive filtration through long tubes containing charcoal, and is then distilled from a fresh portion of charcoal, which is placed with it into the body of the still; the charcoal is suited by its property, noticed in a previous chapter, of absorbing odorous and coloring matters, for abstracting the fusel oil, and hence rendering the whiskey free from that impurity, while, by careful distillation, it is highly rectified and adapted to the purposes of the perfumer. Another quality

is the so-called *absolute alcohol.* This term properly applies to the anhydrous article, but is used commercially to designate the strongest kind sent out by the manufacturers, and nearly corresponding with alcohol fortius of the *Pharmacopœia.* The peculiarity in the preparation of this is the moderate heat employed, and the consequent very slow distillation. It usually has from 90 to 95 per cent. of alcohol, and is very useful as a solvent of some articles which resist the ordinary commercial article. Castor oil is one of these; when the alcohol is in small proportion, a perfect solution will not result, unless the so-called absolute alcohol is used.

The expansion and contraction of alcohol by changes of temperature are of practical importance in purchasing it and in measuring it for use or sale. The following tables, prepared, as the result of experiment, by E. B. Shuttleworth, are taken from the *Canadian Pharmaceutical Journal*, Feb. 1872.

Table exhibiting the volume which 100 *Gallons of Alcohol*, 65 *over proof, at* 60°, *will have when measured at different temperatures.*

Temperature.		Volume of spirit.
Centigrade.	Fahrenheit.	
15.55	60	100.
12.77	55	99.7
10.00	50	99.4
7.22	45	99.2
4.44	40	98.8
1.66	35	98.6
— 1.11	30	98.3
— 3.88	25	98.0
— 6.66	20	97.6
— 9.44	15	97.3
—12.22	10	97.0
—15.00	5	96.6
—17.77	0	96.3
—20.55	— 5	96.0
—23.33	—10	95.7
—26.11	—15	95.4
—28.88	—20	92.2

From this it will be seen that in falling in temperature from + 60 to —20, or 80 degrees, the diminution of volume is 0.048, making the average contraction for each degree to be equal to .0006 of the volume. This agrees within .00001 with the average deduced from a table of Gay-Lussac, which gives the expansion from 60° F. to the boiling point.

Atwood's patent, which has now expired, required the rectification of druggists' alcohol, by distilling it from manganate of potassa, which decomposes the fusel oil, and renders the product unexceptionable.

The chemical tests for fusel oil, commonly prescribed, are: 1st. A weak solution of nitrate of silver (1 part in 40 parts of water) is added to the alcohol, in the proportion of 25 minims to 4 fluid-ounces, and the liquid exposed to a bright light for twenty-four hours. If any fusel oil is present, a black precipitate will separate. This being separated in a filter, which has been previously washed with diluted nitric acid, and again exposed, if the alcohol is reasona-

bly pure will form no precipitate, though if in excess, a further separation of the black oxide will be produced. 2d. To a test-tube half filled with alcohol, slowly add an equal bulk of sulphuric acid; if the spirit be pure it will remain colorless, otherwise the amount of impurity will be shown by the depth of the tint produced.

The three strengths of alcohol officinal in the *U. S. Pharmacopœia* have the following specific gravities: Alcohol fortius, sp. gr. .817; alcohol, sp. gr. .835; alcohol dilutum (alcohol mixed with an equal bulk of water), sp. gr. .941. For some of the pharmaceutical facts in regard to alcohol and diluted alcohol, the reader is referred to the chapter on Tinctures.

Æther et Æther Fortior, U.S.P. (*Sulphuric Ether. Stronger Ether.*)

Ether is prepared by mixing stronger alcohol and sulphuric acid in a glass retort or flask adapted to a suitable condenser, and applying heat of 284° F.; the very volatile ether, contaminated with a little alcohol, is driven over at a low temperature, and collected in the receiver. This is the case as long as the requisite proportions are maintained; but when the acid is largely in excess, which soon comes to be the case unless a continuous supply of alcohol is kept up, the boiling point rises, and other products are produced, among which is ethereal oil, to be referred to again as one of the constituents of Hoffmann's anodyne.

The highly volatile and inflammable nature of ether makes its preparation dangerous, except in establishments where every convenience and safeguard is provided. The direct application of flame to the retort or flask is attended with great danger, and in the event of a fracture or leakage occurring either in the retort or receiver, the proximity of fire might entail the most disastrous consequences. The ether of commerce is made exclusively by manufacturing chemists, who produce it on a large scale by the use of costly leaden apparatus. It is generally pure enough for most of the uses to which it is applied, though not for inhalation. Where alcohol is an impurity, it may be readily separated by shaking up the ether with water, allowing the mixed water and alcohol to subside, and pouring off the ether; it will now be what is called in commerce *washed ether*, or hydrated ether. This contains a small percentage of water, and is the kind adapted for making tannic acid from galls.

Æther fortior of the *Pharmacopœia* is placed among the preparations, and directed to be made by shaking ether with an equal bulk of water, as above, decanting it and agitating it with finely powdered chloride of calcium and lime, a troyounce of each to three pints, allowing it to stand for twenty-four hours, then decanting the ether and distilling half the original quantity, refrigerating with ice-cold water.

It is thus described in the *Pharmacopœia:*—

Stronger ether has a specific gravity not exceeding 0.728. It is extremely inflammable, and does not redden litmus. Shaken with an equal bulk of water, it loses from one-tenth to one-eighth of its

volume. It boils actively in a test-tube, half filled with it and inclosed in the hand, on the addition of small pieces of glass. Half a fluidounce of the liquid, evaporated from a porcelain plate by causing it to flow to and fro over the surface, yields a faintly aromatic odor as the last portions pass off, and leaves the surface without taste or smell, but covered with a deposit of moisture.

Ether causes intense cold by evaporation; the greatest reduction of temperature yet produced is from its admixture with solid carbonic acid. The great volatility of ether, the highly inflammable nature and high specific gravity of its vapor, which is 2.586, combine to make it a most dangerous substance to handle, or even to decant, in the vicinity of flame. It should be kept in bottles of not exceeding a pound capacity in cold situations, as cellars where fire is never kindled, and should always be decanted by daylight. Many disastrous accidents have happened from neglecting this precaution.

Several theories have been advanced to explain the generation of ether; it was supposed to depend on the affinity of SO_3 for H_2O; then it was asserted to be due to the catalytic force of HSO_4; Liebig believed the affinity of HSO_4 for $C_4H_{10}O$ and the decomposition of the resulting sulphovinic acid to be the cause; while Rose found in the basic properties of H_2O, which decomposes the compound of HSO_4, and ether, the true explanation. Williamson, guided by the composition of the compound ethers, which contain the radicals of two alcohols, doubles the formula and regards it as alcohol $(C_2H_5,H)O$, in which H is replaced by C_2H_5, thus making it $(C_2H_5,C_2H_5)O_2$. The formation of ether from sulphovinic acid and alcohol is explained by the following diagram:—

$$\underset{\text{Alcohol}}{C_2H_5HO} + \underset{\text{Sulphovinic acid}}{C_2H_5,HSO_4} = \underset{\text{Ether}}{2C_2H_5,O} + \underset{\text{Sulphuric acid.}}{H_2SO_4}$$

Oleum Æthereum. (*Ethereal Oil. Heavy Oil of Wine.*)

This product is distilled from a mixture of fifty-five troyounces of sulphuric acid with two pints of stronger alcohol, between the temperatures of 302° and 315°, until the liquid ceases to come over, or until a black froth begins to arise in the retort. The yellow ethereal distillate collected in the receiver is exposed to spontaneous evaporation, separated from the watery portion on a filter, washed with water, and added to an equal bulk of ether. This addition is made to prevent decomposition, which is apt to occur if the oil of wine is kept in its pure and concentrated condition. As thus distilled, ethereal oil is a transparent, nearly colorless, volatile liquid, of a peculiar aromatic ethereal odor, and a sharp bitter taste. It is neutral to litmus paper not previously moistened, and has the specific gravity 0.91.

Ethereal oil is rarely met with in commerce, though Dr. Squibb prepares it for sale of standard purity. Some specimens I have met with were sophistications. It is only used in the preparation of Hoffmann's anodyne.

Spiritus Ætheris Compositus, U. S. P. (*Hoffmann's Anodyne.*)

Take of Ether, half a pint.
Alcohol, a pint.
Ethereal oil, six fluidrachms.

Mix them.

If in possession of the pure ingredients, this preparation is readily made; the proportion of the ethereal oil has been doubled in consequence of its being now diluted with an equal bulk of ether.

Hoffmann's anodyne is, however, rarely made by the officinal formula; usually it is prepared by a process which, in its very nature, is certain to give varying results. In the distillation of ether, as already stated, the resulting liquor is liable to vary according to the proportions of the ingredients in the retort. If the alcohol be in due proportion, and the boiling point consequently low, a tolerably pure ether will pass over; but when the acid ingredient comes to be in large excess, sulphurous acid, water, and ethereal oil will come over. Now it is usual with the manufacturers to push the process as far as possible in the first instance, getting a product which contains ether, alcohol, and water, contaminated with light oil of wine and a very small portion of ethereal oil. This is rectified by a second distillation, the first portion (as long as it comes over at or below 54° Baumé) being reserved as rectified ether. The less volatile products are now driven over, and are found to consist of ether, alcohol, and water, impregnated with the oils of wine. This is now made into Hoffmann's anodyne by mixing it with ether, alcohol, or water, as may be required to give it nearly the sensible properties of a standard specimen kept on hand. These properties, however, furnish a very poor criterion of quality to the manufacturer or to the consumer; the milkiness occasioned by dilution with water is varied by the relative proportions of alcohol and ether. If too much alcohol is present, this milkiness is deficient. If too much ether, the opalescence is not diffused, the oil-globules having a tendency to run together, and thus varying the appearance. Professor Procter analyzed five specimens of Hoffmann's anodyne, four from leading chemical manufacturers, and one made by the officinal recipe. These he found to differ in sensible properties, in specific gravity, and in composition. While the U. S. P. specimen marked .8151, one of the others had a sp. gr. .8925, the others being intermediate; one of the manufactured specimens contained very little ether, being chiefly alcohol and water; another contained less alcohol, but more ether; a third had less water than the others, but more alcohol than one, and more ether than the other; while the fourth approached nearer the officinal proportions, though neither of them contained the full proportion of ether. The proportion of heavy oil of wine was not ascertained, as there is no known practicable method of estimating this. It was proved, however, that all the specimens but that by the officinal recipe were deficient in this important ingredient, the odor of which is quite characteristic, and very perceptible, in genuine Hoffmann's anodyne.

According to the officinal standard, Hoffmann's anodyne is a colorless, volatile, inflammable liquid, having an aromatic, ethereal odor, and a burning, slightly sweetish taste. Its specific gravity is 0.815. It is neutral or but slightly acid to litmus. It gives only a slight cloudiness with chloride of barium; but, when a fluidounce of it is evaporated to dryness with an excess of this test, it yields a precipitate of sulphate of barium, which, when washed and dried, weighs six and a quarter grains. When a few drops are burned on glass or porcelain, there is no visible residue, but the surface will be left with an acid taste and reaction. A pint of water, by the admixture of forty drops, is rendered slightly opalescent.

Notwithstanding the deficiencies in the commercial article, this medicine has a great and wide-spread reputation, and indeed there is no medicine of its class so much used; it is prescribed for internal use almost to the exclusion of ether, being adapted to admixture with aqueous solutions.

Some of its favorite combinations will be found under the head of Extemporaneous Pharmacy. Its dose is from 20 drops to f℥j.

Spiritus Ætherеus.

This is the name for the German Hoffmann's anodyne, which is simply a solution of one part (by weight) of ether in two parts of alcohol. It is used for the same purposes and in the same dose as the article officinal with us.

Spiritus Ætheris Nitrosi, U. S. P. (*Spt. Ætheris Nitrici*, Ph. 1850. *Sweet Spirit of Nitre.*)

Take of Nitric acid, four troyounces and a half.
Stronger alcohol, seven pints.
Sulphuric acid, three troyounces and a half.
Copper, two troyounces.

Add the sulphuric acid gradually to twenty fluidounces of the stronger alcohol; when the mixture has become cool, put it into a glass retort connected with a Liebig's condenser, and add the copper and four troyounces of nitric acid. Then cautiously apply heat, and distil thirteen fluidounces at a temperature not exceeding 180°. Remove the heat, let the contents of the retort cool to 90°, add the remainder of the nitric acid, and distil two fluidounces as before. Mix the distillate with the remainder of the alcohol, and transfer the mixture immediately to half-pint bottles, which must be well stopped and protected from the light. (*U. S. P.*)

This process, which has been adopted from the *British Pharmacopœia*, was suggested by Prof. Redwood of London, and has been found to give a satisfactory result; the design in using copper and sulphuric acid is to reduce the nitric to nitrous acid by the copper with which the sulphuric acid unites and leaves the nitrous acid free to convert the alcohol into nitrous ether, which distils over and is afterwards dissolved in the alcohol.

Much of the sweet spirit of nitre is of very deficient strength as

regards its ethereal ingredient, being mixed with water and alcohol to suit the price charged. It is said that the term *spirit. nitri dulc.* is applied by some of the wholesale dealers to the weak article, and *spirit. æther. nit.* to the strong. If skilfully adulterated, its specific gravity would be preserved at about the normal standard, but to an experienced observer it would be deficient in the proper odor, and the sweet and rather pleasant taste. In view of its use as a mild diaphoretic and sedative, especially for children, its admixture with alcohol is highly injurious and criminal.

According to the *Pharmacopœia*, spirit of nitrous ether is a volatile, inflammable liquid, of a pale-yellow color inclining slightly to green, having a fragrant, ethereal odor, free from pungency, and a sharp, burning taste.

It slightly reddens litmus, but does not cause effervescence when a crystal of bicarbonate of potassium is dropped into it. When mixed with half its volume of officinal solution of potassa, previously diluted with an equal measure of distilled water, it assumes a yellow color, which slightly deepens, without becoming brown, in twelve hours. A portion of the spirit in a test-tube half-filled with it, plunged into water heated to 145°, and held there until it has acquired that temperature, will boil distinctly on the addition of a few small pieces of glass.

Spirit of nitrous ether has the specific gravity 0.837, and contains from four and three-tenths to five per cent. of its peculiar ether. It should not be long kept, as it becomes strongly acid by age.

The strength of this spirit may be ascertained by putting a small quantity in a test-tube, mixing with it double its bulk of a saturated solution of chloride of calcium, and shaking together. If one per cent. of the ether rises to the surface, it will be evidence that it contained five per cent., as but one-fifth of the ether is set free by this experiment.

The late eminent Prof. Hare recommended the careful preparation of nitrous ether by the manufacturing chemist, and the admixture of this by the dispensing pharmacist, as follows:—

Nitrous ether, 8 parts; acetic ether, 2 parts; alcohol, 90 parts. The changeable nature of the nitrous ether seems an objection to this otherwise desirable process.

A process for the preparation of this important remedy on a scale adapted to ordinary pharmacists is given in the *Amer. Journal of Pharmacy*, vol. xxviii. p. 289.

Uses.—Spirit of nitrous ether is very extensively used as a mild refrigerant and diaphoretic; in febrile complaints, it is much combined with antimonial wine, citrate of potassium, etc.; as a diuretic it is used in connection with the preparations of digitalis and squill.

Its dose is from ten drops for a child, to two fluidrachms for an adult.

Methylic Alcohol and Dirivatives.

Name.	Source.	Description, etc.
Methylic alcohol. Wood spirit. CH_3HO	Among the products of dry distillation of wood.	Resembles common alcohol in most physical properties; sp. gr. .79; boiling point 142°.
Bichloride of methyl CH_2Cl_2	From gaseous chloride of methyl and chlorine exposed to sunlight.	Colorless liquid; odor like chloroform; sp. gr. 1.344; boiling point 142°.
Formic acid $\overline{Fo}$ $HCHO_2$	In ants; by distilling 1 p. starch, 4 p. MnO_2, and 4 p. water.	Colorless liquid; odor penetrating acid; caustic; reduces the oxides of the noble metals.
Formic ether. Formo-ethylic ether H,C,O,O,C_2H_5	By distilling 8 parts dry $NaO,\overline{Fo}$, 7 alcohol, and 11 p. H_2SO_4.	Colorless aromatic liquid; sp. gr. .945; boiling point 130°; pretty soluble in water, readily in alcohol and ether.
Chloroform. Terchloride of formyl $CHCl_3$	By distilling methylic or ethylic alcohol with chloride of calcium.	Colorless volatile liquid; odor and taste ethereal sweet; sp. gr. 1.50; boiling point 144°; the vapors not inflammable; burns with a wick; not acted on by H_2SO_4; boiling KO decomposes it into $KO,\overline{Fo}$ and KCl.
Chloral hydrate C_2HCl_3O,H_2O	By passing dry chlorine gas through anhydrous alcohol so long as it is absorbed.	It is a white crystalline solid, unacted on by H_2SO_4, but decomposed by alkalies: fuses at 100°.8, boils at 239°; soluble in alcohol, water, ether, and oils. Its aqueous solution should be neutral.
Iodoform. Teriodide of formyl CHI_3	By dissolving 5 p. KO, CO_2 and 6 p. I, in 12 p. water, and heating with 6 p. alcohol until decolorized.	Lemon yellow crystals; odor saffron-like; taste sweetish aromatic; insoluble in water, soluble in alcohol and ether; volatile.
Bromoform. Terbromide of formyl $CHBr_3$	By action of bromine on a solution of potassa in wood spirit.	Colorless liquid; boiling at 150°–152°; congeals at 3°; sp. gr. 2.9.

Medicinal Preparations of the Group of Methyl.

Spiritus formicæ.	Distil two parts from one part ants, two parts alcohol, and one part water. Its activity depends chiefly on the formic acid; now little used, in rheumatism, gout, neuralgia, etc., externally as a rubefacient. Dose, gtt. 40–60.
Chloroformum. (As above.)	Used internally and externally; as an anæsthetic in quantities of fʒj–iij. Dose, gtt. 10 to 60.
Spiritus chloroformi, commonly chloric ether.	Alcoholic solution of chloroform, adapted to dilution. Dose, fʒj.
Iodoformum. (As above.)	Antiseptic and antimiasmatic; produces the effects of iodine without irritation; used for inhalation in lung diseases, and externally in suppositories and ointments. Dose, gr. 1–7.

Chloroformum Venale et Chloroformum Purificatum, U. S. P. (*Commercial Chloroform and Purified Chloroform.*)

Of these products, the first named is placed in the *list* of the *Pharmacopœia* among the products derived from the manufacturing chemist, while the last is a preparation for which a formula is given.

The process for making chloroform consists in distilling alcohol from chlorinated lime; it is practised on a large scale by many

chemists, both in this country and Europe. In England, methylated spirit is resorted to for preparing it, on account of the high price of alcohol; if properly prepared and purified, this is identical with that from alcohol. On the manufacture of chloroform, *see* M. Petattakofer and B. Hirsch, *Amer. Journ. Ph.*, 1861, p. 421, and 1862, p. 42.

Commercial chloroform is a colorless liquid, sp. gr. 1.45 to 1.49; it is contaminated with some impurities, the results of the process, but is cheaper than the purified product, and equally well adapted to use as a solvent in the preparation of liniments, solution of gutta percha, etc. The *Pharmacopœia* test for the commercial variety is as follows:—

Shaken with an equal volume of officinal sulphuric acid in a bottle closed with a glass stopper, it forms a mixture, which separates by rest into two layers; the upper one colorless, and the lower, consisting of the acid, of a brownish hue, which, after the lapse of twenty-four hours, becomes darker, but never quite black.

Chloroform Purificatum. (*Purified Chloroform.*)

Take of Commercial chloroform, one hundred troyounces.
Sulphuric acid, twenty troyounces.
Stronger alcohol, twelve troyounces.
Carbonate of sodium, five troyounces.
Lime, in coarse powder, half a troyounce.
Water, ten fluidounces.

Add the acid to the chloroform, and shake them together, occasionally, during twenty-four hours. Separate the lighter liquid (chloroform), and add it to the carbonate of sodium, previously dissolved in the water; agitate the mixture thoroughly for half an hour, and set it aside; then separate the chloroform from the supernatant layer and mix it with the alcohol. When the mixture has separated into two transparent layers, transfer the chloroform into a dry retort, add the lime, and distil, by means of a water-bath, into a well cooled receiver, taking care that the temperature in the retort does not rise above 153°, until one troyounce of residue is left; keep the distilled liquid in well-stopped bottles.

A colorless, volatile liquid, not inflammable, of a bland ethereal odor, and hot, aromatic, saccharine taste. Its specific gravity is 1.480. It boils at 142°. It is slightly soluble in water, and freely so in alcohol and in ether. When mixed with an equal volume of officinal sulphuric acid in a bottle closed by a glass stopper, and allowed to remain in contact for twenty-four hours, no color is imparted to either. When one fluidrachm is evaporated spontaneously with one drop of a neutral aqueous solution of litmus, the color of the latter is not reddened. The result of the test is the same, if the chloroform, contained in a white glass bottle, has been previously exposed to sunlight for ten hours.

The following additional facts may be useful in examining specimens found in commerce:—

Chloroform is liable to undergo decomposition by age, shown by

the evolution of chlorine gas; in order to preserve it from this deterioration when commenced, the addition of eight drops of alcohol to each fluidounce is recommended. Alcohol is, however, a common adulteration of chloroform, and may be detected as follows: Potassium does not decompose pure chloroform, the surface of the metal being only covered with small gas bubbles; if much alcohol be present, the entire mixture becomes quite colored, attended with the liberation of acid fumes. Chloroform, on being shaken with the nearly pure orange-colored mixture of bichromate of potassium, sulphuric acid, and water, and allowed to remain quietly for a time, assumes a light-green color; if 5 per cent. of alcohol is present the mixture separates into two sharply-divided layers, the lowest having a green color. The same occurs when ether is present. If water is present, potassium immersed in it will be rapidly oxidized.

The chief impurities, however, are products of the reaction, which, in properly rectified chloroform, or chloroform made from pure alcohol, are never present; these subtle carbohydrogen compounds are sometimes perceptible as oily-looking globules, floating through the liquid, and are always shown by the color imparted by admixture with sulphuric acids as above.

Hager announces the following conclusions from his experiments on chloroform: 1st. Chloroform does not decompose by action of solar rays only. 2d. Rapid decomposition takes place under the combined action of air and solar rays; and hydrochloric acid, carbonylchloride, formic, and traces of oxalic result, and in some cases free chlorine. 3d. If the air has access to chloroform even in the dark, decomposition ensues. 4th. An admixture of from .75 to 1 per cent. of alcohol suffices to preserve it and prevent decomposition. 5th. Commercial chloroform contains, besides chloroform, other chlorinated compounds, which are separated with difficulty. (For further remarks, see *Proc. Amer. Ph. Assoc.* for 1870, 243, 244.)

Chloroform was first prepared, under the name of "Chloric Ether," in 1831, by Samuel Guthrie, of Sackett's Harbor, New York. A medicine of American origin, it has become known and extensively used in all parts of the civilized world.

One of the chief uses of chloroform in medicine, as first announced by Prof. Simpson, of Edinburgh, is for the purpose of producing an anæsthetic or benumbing effect during surgical operations and parturition. This effect is produced by the inhalation of its vapor, which appears to be absorbed by the blood, and, by acting on the nervous centres, to suspend their functions. One of the chief causes of the fatal effects of chloroform given by inhalation has been its occasional imperfect quality, as found in commerce. Though the increase of its use of latter years is well known, the number of deaths reported has been greatly diminished, and the explanation is undoubtedly found in the improved quality of the article of commerce, as well as in the greater care and judgment with which it is now administered. The quantity necessary to be

inhaled varies in different individuals, though perhaps the most usual dose by the lungs is of chloroform f℥j to f℥iij—of ether f℥ss to f℥ij. It is also given by the stomach. Dose, 20 to 60 drops; and used externally in anodyne liniments.

It is recommended as a remedy against sea-sickness; in doses of from five to ten drops, given in a little syrup or cognac, it alleviates the nausea and resuscitates the patient from his extreme prostration. I have tried this, as I confidently believe, with advantage, though not with complete relief.

It is a powerful solvent of camphor, caoutchouc, gutta-percha, wax, resins, iodine, and of the vegetable alkalies and neutral crystalline principles generally. Its property of dissolving camphor in so large proportion adapts it as a vehicle for that medicine, especially for topical applications.

Spiritus Chloroformi, U. S. P. ("*Chloric Ether.*")

Take of Purified chloroform, a troyounce.
Diluted alcohol, twelve fluidounces.

Dissolve the chloroform in the stronger alcohol.

This is a new officinal, of utility to the physician as a substitute for chloroform itself, in cases where it is to be used by the stomach. The proportions are adjusted to prevent ready separation of the ingredients on admixture with ordinary tinctures and aqueous mixtures, it may be given in doses of a fluidrachm or two in cases of flatulence, colic, etc., and is a useful addition to various anodyne combinations.

Liquor Gutta-perchæ, U. S. P. (*Solution of Gutta-percha.*)

Take of Gutta-percha, in thin slices, a troyounce and a half.
Purified chloroform, seventeen troyounces.
Carbonate of lead, in fine powder, two troyounces.

To twelve troyounces of the chloroform, contained in a bottle, add the gutta-percha, and shake occasionally until it is dissolved. Then add the carbonate of lead, previously mixed with the remainder of the chloroform, and, having several times shaken the whole together at intervals of half an hour, set the mixture aside, and let it stand for ten days, or until the insoluble matter has subsided, and the solution become limpid, and either colorless or of a pale straw-color. Lastly, decant the liquid, and keep it in a well-stopped bottle. In practice it has been found much easier to add three times as much chloroform to the gutta-percha, and, having marked on a retort the measure which the resulting preparation should make from the solution when filtered through paper into the retort, draw off sufficient chloroform to leave the required amount of solution in the retort.

This new officinal preparation is placed in the *Pharmacopœia* under the head of Liquores. Like collodion, it is designed to be applied to cuts or abrasions, on evaporation leaving a film which protects the part to which it is applied, preventing the drying

action of the atmosphere, and promoting the healing process. The carbonate of lead is used to precipitate the coloring matter of the gutta-percha, so that the solution is transparent and of a light straw-color. It may be dispensed in vials connected with a camel-hair pencil secured to the cork, as described under the head of Collodion.

Chloral, U. S. P.

This is a new officinal in the *list* of the *Pharmacopœia*, 1870, and, although discovered in 1832, was not introduced into medical practice till Dr. Leibreich, of Berlin, in 1869, called the attention of the medical profession to its powers as a hypnotic.

The reactions which result in the formation of chloral are thought to be as follows: Aldehyd and hydrochloric acid are first formed; and these, with some of the alcohol, yield monochlorinated ether, $\left.\begin{matrix} C_2H_5 \\ C_2H_4Cl \end{matrix}\right\} O$, which on further additions of chlorine gives tetrachlorinated ether, $\left.\begin{matrix} C_2H_5 \\ C_2HCl_4 \end{matrix}\right\} O_2$, and this with water furnishes chloral, some alcohol, and some hydrochloric acid. The action of chloral hydrate generally is supposed to depend upon its decomposition by contact with the alkalies in the system, developing chloroform in its purity and in a manner peculiarly adapted for its best medical effect. The dose is from ten to fifty grains; the medicine is given in solution, with a little syrup added at the time of taking it. (For interesting papers on this subject see *Proc. Amer. Phar. Assoc.*, vol. xix. 245, 543.)

Iodoform, U. S. P.

This preparation has been made officinal in the last edition of the *Pharmacopœia*. It may be made by mixing two parts of carbonate of potassium, two of iodine, one of alcohol, and five of water, heating till colorless, and then pouring off into a suitable vessel to deposit; it is then thoroughly washed and dried. It is in lemon-yellow plates, of a peculiar and very persistent odor; it is sparingly soluble in water, more so in alcohol, ether, and oils.

It has been recommended in those cases where iodine is indicated, but is free from the irritating action that characterizes the iodine salts; the usual dose is from one to three grains three times a day, given in pilular forms.

Bromal Hydrate.

A series of trials of bromoform were made in the Berlin Pathological Institute under the direction of Leibreich; according to the observations bromal hydrate undergoes the same change that chloral does, bromoform being formed by the action of the alkalies in the blood; the method adopted was to give fourteen grains soda biscuit in the morning and mid-day, and at night two to six grains of bromal hydrate.

Bromoform.

Dr. Robertson has used this remedy and found the effects similar to those produced by chloroform; the dose is not stated.

Derivatives of Butylic Alcohol.

Name.	Source.	Description, etc.
Butylic alcohol C_4H_9HO	In the fusel oil of alcohol from beet molasses.	Colorless liquid; odor more pleasant than fusel oil; soluble in 10 parts water; with fusing KO yields $\overline{But}$.
Butyric acid, $\overline{But}$ $HC_4H_7O_2$	By fermenting milk sugar with old cheese at 85° and adding $CaCO_3$.	Colorless liquid; odor of rancid butter; sp. gr. .96; boiling point 328°; soluble in water, alcohol, and ether.
Butyric ether $CH_7O_2C_2H_5$	From 2 p. $\overline{But}$, 2 p. alcohol and 1 p. H_2SO_4 at 175°; or by distilling CaO, $\overline{But}$, H_2SO_4, and alcohol.	Colorless liquid; odor of pineapples; sp. gr. .904; boiling point 239°; soluble in alcohol and ether in all proportions, little in water.

Derivatives of Amylic Alcohol.

Name.	Source.	Description, etc.
Amylic alcohol, fusel oil $C_5H_{12}O$	Formed by the fermentation of potatoes and grain; contained in whiskey.	Colorless liquid; odor penetrating, exciting to coughing; taste burning; sp. gr. .818; boiling point 270°; crystallizes at —4° F.; inflammable; soluble in alcohol and ether in all proportions, little in water.
Nitrite of amyl $C_5H_{11}NO_2$	.....	Yellowish liquid; sp. gr. .877; boiling at 96° C.; spicy odor, fruity taste; soluble in alcohol and ether; insoluble in water.
Valerianic acid, $\overline{Val}$ C_5H_9O,OH	In valerian; by distilling 10 p. K_2CrO_4,CrO_3, 15 p. H_2SO_4, and 2 p. fusel oil.	Colorless oily liquid; odor of valerian and old cheese; taste burning acid; sp. gr. .937; boiling point 347°; inflammable; soluble in 30 p. water, in all proportions in alcohol and ether; dissolves camphor and some resins.
Amylo-valerianic ether $C_5H_{11}C_5H_9O_2$	The oil floating on the distillate in preparing $\overline{Val}$.	Colorless oily liquid; odor of apples; sp. gr. .88; boiling point 370°.
Amylo-acetic ether $C_5H_{11}C_2H_3O_3$	By distilling 2 p. $K\overline{Ac}$, 1 p. H_2SO_4, and 1 p. fusel oil, and rectifying over lime.	Colorless liquid; odor of pears; sp. gr. .857; boiling point 272°; decomposed by KO.

Butyric Acid. $\overline{But} = HC_4H_7O_2$.

As obtained by the saponification of butter, some difficulties are presented in freeing it of caprylic, caprinic, and vaccinic acids; it is therefore best to prepare it artificially by butyric fermentation, for which purpose 100 parts of starch sugar or cane or milk sugar are dissolved in water, and set aside in a warm place, with 10 parts of old cheese; or a mixture of 100 parts of sugar, 150 parts milk, and

50 parts of powdered chalk, is allowed to ferment in a warm place; if diluted with water, fermentation takes place readily. After the cessation of the evolution of gas, the liquid, on evaporation, furnishes butyrate of calcium, 10 parts of which are to be dissolved in 40 parts of water, and distilled with 3 or 4 parts of muriatic acid; from the distillate the acid is separated by saturating it with chloride of calcium, the oily liquid is rectified, and that portion coming over at 327° is preserved as pure concentrated butyric acid.

Alcohol Amylicum, U. S. P. (*Fusel Oil* = $C_5H_{11}HO$.)

To obtain this in a state of purity from the ordinary grain fusel oil, which may be obtained at distilleries, the crude fusel oil is agitated with an equal bulk of solution of table salt, the water removed and the oil distilled with about its own weight of water; the potato fusel oil distils with the vapors of water, and the receiver contains water holding the last traces of alcohol in solution, upon which the amylic alcohol floats.

An oily, nearly colorless liquid, having a strong, offensive odor, and acrid, burning taste. Its specific gravity is 0.818, and its boiling point between 268° and 272°. It is sparingly soluble in water, but unites in all proportions with alcohol and ether. It does not take fire by contact with flame, and, when dropped on paper, does not leave a permanent greasy stain.

The inhalation of its vapor and its internal administration are poisonous, producing coughing, nausea, vomiting, vertigo, fainting, prostration of the lower extremities, convulsions, asphyxia, and death. Ammonia has been recommended to counteract these deleterious effects.

It is not used in medicine, except rarely as an external irritant in rheumatic and other painful affections, but has attained considerable importance in the arts, chiefly for the artificial production of perfumes and fruit essences, and for the preparation of valerianic acid by the use of oxidizing agents.

Nitrite of Amyl.

Nitrite of amyl is made, according to Prof. Maisch's process, by mixing in a capacious retort an equal bulk of amylic alcohol, purified, and nitric acid, applying a moderate and gradually increasing heat until the mixture approaches the boiling point, when the fire is removed and the reaction allowed to proceed; this substance has been tried as an anæsthetic, and is very powerful in its action; it stimulates the heart more powerfully than any other remedy.

Artificial Fruit Essences.

The artificial fruit essences now so largely employed for making artificial fruit syrups, and as flavors for culinary purposes and confectionery, belong to this class of ethers; they are solutions of compounds of organic acids with ordinary ether and amylic ether, in

deodorized alcohol. But little practical information has been published with reference to their preparation, the manufacturers keeping their processes secret, in consequence of which the quality of the essences, as they occur in commerce, varies exceedingly.

The following processes for some of the most prominent of these essences, in connection with the foregoing syllabi, will be found to facilitate their preparation, which, to be successful, must be conducted with care and with close attention to the results of experience.

Jargonelle pear essence is an alcoholic solution of amylo-acetic ether, as given in the syllabus, in proportions indicated by convenience.

Bergamot pear essence is a solution of five parts of amylo-acetic ether, one and a half parts of acetic ether, in from 100 to 120 parts of alcohol.

Apple oil consists of an alcoholic solution of one part of amylo-valerianic ether dissolved in six or eight parts of alcohol.

Pineapple essence consists of one part of butyric ether dissolved in eight or ten parts of alcohol; or the potassa soap of butter is dissolved in alcohol, and this solution distilled with an excess of sulphuric acid. Prepared by the latter process, the odor is somewhat modified by the presence of capronic, caprylic, and caprinic ethers.

Banana essence consists of a mixture of amylo-acetic ether, and some butyric ether dissolved in alcohol. A more perfect imitation is that made with acetate of amyl alone.

Essence of raspberries is usually made by mixing acetic ether with an alcoholic essence of orris root.

Quince Essence.—In making this essence *pelargonic acid* has to be prepared as a first step. This acid is contained in the oil of Pelargonium roseum, from which it may be obtained by combining it with potassa; but it is more advantageously made from oil of rue, by heating it in a retort with nitric acid previously diluted with an equal measure of water, removing from the fire as soon as the reaction commences, afterwards boiling with cohobation until nitrous acid vapors cease to be evolved; the oily acid is then removed, washed with water, combined with potassa, and a neutral strong-smelling oil separated, after which the solution of pelargonate of potassium is decomposed by sulphuric acid.

Pelargonic acid is now sufficiently pure for the preparation of the ether; it still contains a resinous substance, from which it may be purified by rectification, combining with caustic baryta, and decomposing the crystallized salt with diluted sulphuric acid. Pelargonic acid, by a continued digestion with alcohol, is converted into pelargonic ether, which is obtained purer and in a shorter time, by saturating an alcoholic solution of pelargonic acid with muriatic acid gas, washing the separated ether with water, and drying it over chloride of calcium. If the pure ether is sought this may be rectified; it consists of $C_2H_5,C_9H_{18}O_2$.

The *pelargonic*, also called *œnanthic*, *ether*, dissolved in alcohol, constitutes the essence of quince. An impure pelargonic ether is

said to be used in England for imparting to potato spirit the flavor of whiskey.

Fusel oil of wine was supposed to be *œnanthic ether*, and has been frequently confounded with pelargonic ether. According to late investigations of Fischer, it is a mixture of caprinic, caprylic, and other allied ethers. Probably, however, the fusel oil contained in the different wines varies in the kinds and proportions of the ethers. This fusel oil is the cause of the persistent smell of all or most wines, and is quite distinct from their *bouquet*, which in some wines is wanting altogether. It is obtained by careful distillation of the ferment of wines mixed with half its measure of water, a little œnanthic acid may be removed by agitation of the distillate with some carbonate of sodium, the liquid in then heated, the ether rises to the surface, and is obtained free of water by standing over chloride of calcium.

The *bouquet of wines*, which is formed after fermentation, is probably due to the presence of acetic, butyric, valerianic, and other ethers; but our knowledge of its true chemical nature is very limited.

Most alcoholic liquors are subject to adulteration and sophistication, for which purposes some of the artificial ethers are used, usually together with sweet spirits or alcohol freed from fusel oil. Thus formic ether is used to impart to alcohol the flavor of arrack, and constitutes the chief ingredient in what is called *essence of arrack;* and butyric, valerianic, and caprylic ethers enter into the composition of the so-called *essence of rum.*

CHAPTER V.

FIXED OILS AND FATS.

The fixed oils and fats form so natural a group that they may be conveniently classed together, though derived respectively from animal and vegetable kingdoms.

They resemble the preceding groups of ternary organic principles in being nutritious in the sense in which that term applies to non-nitrogenized principles. The very large proportion of carbon they contain peculiarly adapts them to maintain, by combustion in the lungs and capillaries, the heat required in the various processes of the economy. In medicine, they are used for this in connection with certain demulcent, alterative, and cathartic properties, pertaining to particular individuals of the group. They constitute the chief vehicles for medicines to be applied externally, whether in ointments in which the oil is usually not decomposed, or in liniments and plasters, in some of which a decomposition of the oil is intentionally effected. The fixed oils enter largely into the food

of animals, and of the human race; they are accumulated particularly in the fruit and seeds of plants, and exist, associated with other nutritive materials, in the straw and stalks as well as the seed of the cereal grasses.

The following proportions of fixed oils have been ascertained to exist in the several substances named: in Indian corn, 8.8 per cent.; oats, 6.9; fine wheat flour, 1.4; bran from wheat, 4.6; rice, 0.25; hay and straw from 3 to 5; olive seeds, 54; flaxseed, 22; almonds, 46; walnuts, 50; cocoa-nut, 47; yelk of eggs, 28; cow's milk, 3.13 per cent.

Adulterations.—The chief adulterations to which the fixed oils are subject, are mixtures of the finer and more expensive kinds with the cheaper. These may be detected by variations of the specific gravity from the normal standard, though as the several oils only vary from 865 to .970 sp. gr., this means of detection becomes a matter of considerable nicety. It has been proposed to apply this test at the temperature of boiling water, but we have too little data to make this generally available. The sp. gr. of each of the fixed oils mentioned in this work, as far as known, is given in the syllabus which follows.

The odor of oils, if carefully observed, will be found a good means of detecting their adulterations, especially when heat is applied. A known pure sample, being obtained, may be heated in a spoon and compared with a quantity of the suspected oil similarly heated.

The presence of fish oil in the vegetable oils is detected by passing a stream of chlorine through them. The pure vegetable oils are not materially altered, but a mixture of the two turns dark brown or black.

On adding a drop of concentrated sulphuric acid to about ten drops of a fixed oil, coloration is produced, varying with the different oils: fish oils turn reddish or violet; rape seed and oil of black mustard greenish-blue; olive oil yellowish, then greenish; linseed oil dark-brown and black.

Solubility in alcohol is another fact which is useful in determining the genuineness of oils. Castor oil is soluble in its own weight of alcohol of .820 sp. gr. Croton oil dissolves in the same proportion in alcohol of .796 sp. gr. Olive oil is nearly insoluble. Oil of almonds dissolves in 25 parts of cold and 6 parts of boiling alcohol.

The boiling point of fixed oils varies from 500° to 600° F., so that we might detect the admixture of the volatile oils, hydrocarbons from coal, etc., by raising the temperature and noticing the point at which ebullition commences, and the nature of the distillate. The melting and the solidifying points of solid fats are liable to variations in the case of those yielding glycerin by saponification. If allowed to cool while in a melted state, their temperature after first sinking becomes constant for a time, and then exhibits a sudden rise. This occurs at a definite point for each fat, which is therefore called the natural point of solidification, although the fat may be considered at a time in a state of superfusion. Other

fats exhibit only one point of solidification, which coincides with the melting point.

Chemical History.—The vegetable and animal fats are mixtures of different proximate constituents, each of which consists of a fatty acid and a base, analogous in behavior to the ethers treated of in the last chapter, with the difference that it requires three equivalents of acid for saturation. Separated from its acid it combines with water so that its alcohol *glycerin* is obtained. The ether which exists in the fats has been called by Berzelius oxide of lipyle, and has also received the name of oxide of glyceryle; glycerin being its hydrated oxide.

When a fixed oil is treated with an alkali, the latter combines with the fatty acids and forms a soap. Soaps, therefore, are salts, the acids of which are derived from the fixed oils; if the base is an alkali they are soluble in water, and to a certain extent also in alcohol; the soaps of the alkaline earths and the metallic oxides are insoluble in both menstrua; the term soap is for this reason not commonly applied to those compounds, and the *Pharmacopœia* recognizes one of them, the lead soap, by the name of *Emplastrum Plumbi.*

The acids which are present in the natural fats are mostly homologous compounds of the general formula $C_nH_nO_2$. The first two of the series, formic acid, CH_2O_2, and acetic acid, $C_2H_4O_2$, are thin liquids, readily soluble in water and alcohol; the next two, propionic, $C_3H_6O_2$, and butyric acid, $C_4H_8O_2$, are oily liquids, soluble in water, but separated from their solutions by chloride of calcium, and boil at 287° and 314°.6 respectively. The following acids of the series are oily and but sparingly soluble in water:—

Valerianic acid	$C_5H_{10}O_2$	In valerian root, and the fat of the dolphin; boils at 347°.
Capronic "	$C_6H_{12}O_2$	In cow butter, and cocoa-nut oil; boils at 388°.
Œnanthylic "	$C_7H_{14}O_2$	Formed in the oxidation of castor oil, etc., besides other products; boiling point 425°.
Caprylic "	$C_8H_{16}O_2$	In cow butter, cocoa-nut oil, human fat, and in the fusel oil of rye, rice, and beet-root spirit; boiling point 457°.
Pelargonic "	$C_9H_{18}O_2$	In pelargonium roseum, and by the oxidation of oil of rue; boiling point 500°.

All the above liquid acids possess a strong odor; some of them having been sufficiently treated of in the last chapter, and others being reserved for the chapter on organic acids, we may pass to a series of the solid fatty acids, which, with the exception of the first, are destitute of odor.

Caprinic acid	$C_{10}H_{20}O_2$	In cow and goat butter, cocoa-nut oil, various fusel oils, etc.; fusible at 80°.5.
Laurinic "	$C_{12}H_{24}O_2$	Laurostearic acid. In the fruit of Laurus nobilis, in cocoa-nut oil, pichurim beans, and in spermaceti; fusible at 110°.5.
Myristic "	$C_{14}H_{28}O_2$	In the expressed oil of nutmegs; fusible at 126°.8.
Palmitic "	$C_{16}H_{32}O_2$	In palm oil, in Chinese wax, tallow, suet, in human fat, butter, lard, olive oil, cocoa-nut oil, wax, spermaceti; $\frac{4}{5}$ of myrtle wax is this acid; by fusing oleic acid with HO,KO; fusible at 143°.6.
Margaric "	$C_{17}H_{34}O_2$	Is a mixture of 10 p. stearic and 90 palmitic acid.
Stearic "	$C_{18}H_{36}O_2$	In suet, lard, cocoa-nut oil, and most other animal and vegetable fats; fusible at 156°.6.
Arachic "	$C_{20}H_{40}O_2$	In the fruit of Arachis hypogæa; fusible at 167°.

It will be observed that the members of the series commencing with caprinic acid differ from the next following by C_2H_4; whether there are any natural fatty acids between those mentioned in the syllabus has not been definitely settled. Some other fatty acids, containing more C than the above, have been discovered, but it is asserted that they have not been obtained in a pure state; we name only—

Behenic acid	$C_{22}H_{44}O_2$	In the Behen oil from Moringa aptera.
Cerotinic "	$C_{27}H_{54}O_2$	In beeswax, in the free state, and in Chinese wax; fusible at 170°.

Besides these acids there occur others in fats of the composition $C_nH_{n-2}O_2$; the series is not nearly as complete as the foregoing, and it is uncertain even whether the first one mentioned in the syllabus really belongs to it. The following comprises the few that are known:—

Carbonic acid	C_2O_4	$=(2CO_2)$. Gaseous.
Acrylic "	$C_3H_4O_2$	By the oxidation of acrolein; liquid.
Crotonic "	$C_4H_6O_2$	In croton oil; not acrid nor purgative; liquid.
Damaluric "	$C_7H_{12}O_2$	In the urine of man, the cow, and the horse; liquid.
Moringic "	$C_{15}H_{28}O_2$	In the oil of Moringa aptera; solid at 32.°
Hypogæic "	$C_{16}H_{30}O_2$	Physetic acid. In the oil of Arachis hypogæa and the liquid fat of the Cetaceæ; fusible at 93 °
Gëadic "	$C_{16}H_{30}O_2$	By NO_3 from the former; fusible at 100.°
Oleic "	$C_{18}H_{34}O_2$	In the fat of most animals, and in all the undrying vegetable oils; solid at 25°; oxidizes readily.
Elaic "	$C_{18}H_{34}O_2$	From oleic acid by NO_3; inodorous, tasteless; fusible at 111°.
Balænic "	$C_{19}H_{36}O_2$	In the oil of Balæna rostrata; solid at 40°.
Erucic "	$C_{22}H_{42}O_2$	Sinapic acid. In the oil of mustard; fusible at 93°.

A few other acids of a different composition are met with in some fixed oils, among which we mention—

Olinic acid.	Compos. (?)	In the drying oils, linseed, nut, hemp-seed, poppy-seed oil, etc.
Ricin-oleic acid	$C_{18}H_{34}O_3$	In castor oil; solid at about 15°.

Most of these acids are combined, as has been stated above, with the ether of a triatomic alcohol, the oxide of glyceryle; but some fatty bodies contain, either besides this or altogether, other bases, of which the following syllabus will give a view; they are the ethers of monatomic alcohols:—

Oxide of cetyle $C_{16}H_{33}(OH)$	In spermaceti with palmitic acid (cetin).
" ceryle $C_{27}H_{55}(OH)$	In Chinese wax with cerotinic acid.
" metyle $C_{30}H_{60}(OH)$	In beeswax, the portion insoluble in boiling alcohol, with palmitic acid (myricin).

The compounds of the fatty acids with the oxide of glyceryle are, by common consent, called by the name of the acid, changing the termination *ic* into *in*. Thus myristin is $C_3H_8O_3,3C_{14}H_{28}O_2$; palmitin, $C_3H_8O_3,3C_{16}H_{32}O_2$; stearin, $C_3H_8O_3,3C_{18}H_{36}O_2$; arachin, $C_3H_8O_3$, $3C_{20}H_{40}O_2$; olein, $C_3H_8O_3,3C_{18}H_{34}O_2$. All these fats contain three equivalents of acid, but others with two and one equivalent have been obtained artificially; they are designated in organic chemistry by prefixing to the former the word *tri*, to the next *di*, and to the last *mono*. Ordinary stearin is, according to the chemical nomen-

clature, *tristearin;* the artificial *distearin* has the formula $C_3H_8O_3$, $HO,2C_{18}H_{36}O_2$, and the *monostearin* $C_3H_8O_3,2HO,C_{18}H_{35}O_2$.

To obtain these acids in a pure state is usually a matter of difficulty; fractional precipitation must be frequently resorted to.

Emplastrum Plumbi, U. S. P. (*Lead Plaster.*)

Take of Oxide of lead, in fine powder, thirty troyounces.
Olive oil, fifty-six troyounces.
Water, a sufficient quantity.

Sift the oxide of lead into the oil, contained in a suitable vessel, of a capacity equal to twice the bulk of the ingredients. Then add half a pint of boiling water, and boil the whole together until a plaster is formed; adding from time to time, during the process, a little boiling water, as that first added is consumed.

This is made usually on a large scale by manufacturing pharmacists, some of whom make it, with its kindred preparations, their leading or exclusive article of manufacture.

The process requires that olive oil (lard oil does not produce a nice product) should be boiled with finely-powdered oxide of lead (litharge) and water for a long time, until they unite into a mass of a soft solid consistence, which is tenacious, and readily rolled upon a wet marble slab into rolls of suitable size, which are allowed to harden by maceration in a trough of cold water and subsequent exposure to the air; one gallon of oil yields about twelve pounds of plaster.

Lead plaster is usually found in commerce, in rolls of various sizes, from half an ounce to half a pound in weight, called *simple diachylon*, or lead plaster; sometimes, though rarely, it is spread upon cotton cloth by machinery, and sold by the yard like adhesive plaster cloth. It is milder and less irritating in its action upon highly inflamed surfaces, though less adhesive than that well-known and useful application. Postponing to another chapter the practical details in regard to these, and the numerous compounds into which they enter, it will be appropriate in this place to introduce to notice, what was formerly a residuary product of the manufacture of lead plaster, but is now made directly from fixed oils.

Glycerin. $C_3H_8O_3$.

Glycerin is a colorless, odorless, sweet liquid, resembling syrup, having a sp. gr. of from 1.25 to 1.2667; it may be classified among pseudo sugars (*see* page 376), but in chemical behavior it is a triatomic alcohol of the hypothetical radical glyceryle, C_3H_5. Glycerin is separated from oils in the process of their saponification, and may be obtained by evaporation from the water in which lead plaster has been made, care being taken to precipitate any lead held in solution by sulphuretted hydrogen, and to drive off the excess of this gas by heat.

There are several qualities of glycerin in our markets; the cheapest is made from the waters from which soap has been sepa-

rated; that which is collected as a residuary product from the plaster manufacturer has been almost superseded by that distilled from fats by highly heated steam.

Of the latter, which is the best variety, that imported from Price's Candle Co., London, and that made by Henry Bower, of Philadelphia, are to be preferred; they are both destitute of odor, and have nearly the requisite specific gravity. These articles are believed to be made from palm oil, while that obtained from the refuse of the manufacture of stearin candles, from lard, is seldom destitute of an odor when heated, which is fatal to its use for a large number of the purposes for which it is designed.

When made by distillation, glycerin is liable to be contaminated with *acrolein*, a peculiar volatile principle to which it owes its acridity. Recent chemical investigations show that acrolein is formed during the dehydration of glycerin even in vacuo. Some specimens have a saline taste, evincing important impurities in view of the uses to which it is applied. Among the impurities noted by different writers, are oxalic and formic acids, although this is denied by others; nitric acid has been observed by Schepky, and butyric acid by Perutz. In the common grades the bad-smelling fatty acids are often observable.

Glycerin is sometimes used to impart sweetness (age) and an oily appearance (body) to liquors, and thus labelled is sold to dealers for those purposes.

The following description of glycerin is from the *U. S. Pharmacopœia:*—

A colorless, inodorous, syrupy liquid, of a sweet taste, and having the specific gravity of 1.25. It is soluble in water and in alcohol, but not in ether. Exposed to a full red heat, it takes fire, and burns with a blue flame. It is destroyed by distillation in contact with air, but may be distilled unchanged with steam. It combines with potassa and baryta, and also with sulphuric acid. When diluted with water, it affords no precipitate with hydrosulphate of ammonia or ferrocyanide of potassium.

It is much employed as a substitute for oils, having a remarkable property of soothing irritable conditions of the mucous surfaces, and at the same time mixing in all proportions with water, and with most aqueous mixtures.

It is a most useful application in the dry and parched condition of the mouth so often present in disease, to which it may be applied either by painting it over the dry surface with a brush, or by swallowing it diluted with water. Highly concentrated glycerin will tend to increase the dryness of the mouth by its power of absorbing moisture, and for this reason should be diluted before being used for this purpose. For a certain form of deafness resulting from dryness of the tympanic membrane it is one of the best of remedies. It is used in certain scaly skin diseases, as lepra. It is a useful application to sore nipples, also to burns and excoriated surfaces, and is added to poultices to keep them moist. Its substitution for almond and olive oil, in the preparation of delicate ointments, is

seldom productive of advantage; it must be remembered that it is not perfectly miscible with the fixed oils. It is not liable to become rancid as oils are, and it imbibes the essential oils from plants digested in it with remarkable avidity, so that it is well adapted to the preparation of liniments and lotions; it is also miscible with soaps. From its remarkable solvent power over chemical agents it is much used in pharmacy, and the name glyceroles (glycerites, *U. S. P.*) is applied to solutions containing it. Glycerin is an excellent vehicle for subacetate of lead, which, on admixture with common oils, as in Goulard's cerate, is always converted into a compound of the oil-acid with oxide of lead; and, on admixture with water, as in lead-water, immediately begins to be decomposed, depositing carbonate of lead, so that the solution in a short time becomes inert. Glycerin is miscible in all proportions with liquor plumbi subacetatis, and under the name of *Linimentum plumbi subacetatis*, a formula is inserted which I think an improvement on any of the old preparations of lead.

The solvent power of glycerin is so great, that since its general introduction to popular use in pharmacy, many substances heretofore prescribed with little satisfaction have been used with great success by reason of their combination with glycerin. The following is a list of the class of substances generally soluble in it:—

Bromine,	Alkalies,	Tannin,
Iodine,	Alkaline earths,	Vegetable alkalies,
Iodide of sulphur,	Neutral salts,	Salicin,
Chloride of potassium,	Vegetable acids,	Santonin.

Nitro-glycerin or Glonoin. $C_3H_5(NO_2)_3O_3$.

This compound, which for years past has attracted some little attention as a remedy for headache, is prepared by adding ½ oz. anhydrous glycerin, with constant agitation, to a mixture of 2 oz. sulphuric and 1 oz. fuming nitric acid, pouring it into 50 oz. water, and washing it upon a filter.

It is a colorless oil possessing a sweet taste, sp. gr. 1.28, soluble in 180 p. water and very readily soluble in alcohol and ether; when heated it frequently explodes; even at ordinary temperature nitrous acid is sometimes evolved and the residue consists of oxalic acid and glyceric acid. A drop of the acid brought in contact with the lips, or even the vapors produce the most distressing headache. It is said to have been prescribed by homœopathic practitioners.

The chief use of this article is in the arts as a substitute for gunpowder in blasting, it possessing far greater power; but the terrible destruction which results from its accidental explosion renders it as dreadful as it is efficient.

As before mentioned, only the alkaline soaps are soluble in water and alcohol; their consistence varies with the alkali, the potassa soap being the softest, the soda soap invariably harder than the former. The following list comprises those which are most usually

employed in medicine, though occasionally the soap of a finer oil than olive oil, like the cocoa-nut oil soap, or some highly odorized one, like Windsor soap, is preferred.

Soaps used in Medicine.

Sapo, Castile soap.	From olive oil and soda; white or mottled; used as an antacid, excipient in pills, linimentum saponis. *U. S. Ph.* 1860.
Sapo vulgaris, common soap.	From animal oil and soda; used externally only in the preparation of opodeldoc, linim. saponis camphor. *U. S. Ph.* 1850.
Sapo viridis, S. niger, S. mollis, soft green or black soap.	From potassa and various animal and vegetable fats; used in itch.
Emplastrum plumbi, lead plaster.	From litharge and olive oil; forms the basis of most plasters. (*See* Emplastra.)

Of the soaps, perhaps none is more really useful for ordinary domestic and for surgical purposes than the genuine Castile soap, abundantly and cheaply supplied in our markets. Palm soap is second only to this in its emollient properties. The introduction of suet (soap-fat) is a common means of increasing the frothing properties of soap, and the foregoing being quite destitute of this ingredient are unsuited to use in shaving. Soluble glass, silicate of alkali, is now introduced into the cheap soaps of commerce, by which an immense saving of the fatty ingredient is attained, and the use of resin, formerly employed for the same purpose, is superseded.

In the *U. S. Pharmacopœia* of 1860, only Castile soap is officinal; it is designated Sapo, soap made with soda and olive oil. Sapo vulgaris, common soap, formerly officinal for the preparation of solid opodeldoc, has been dismissed with that preparation. Soap made with vegetable oils is generally soluble in cold alcohol; that made with suet and animal oils is insoluble in alcohol except by the aid of heat.

List of the Principal Fixed Oils and Fats used in Medicine.

1. Vegetable Oils.

Oleum olivæ (sweet oil or olive oil).	From the fruit of Olea Europæa, by expression, sp. gr. .9109 to .9176; a light yellow; nearly inodorous; of sweet oily taste; in ointments, plasters, for culinary purposes, and perfumery.
Oleum amygdalæ dulcis.	From kernels of fruit of A. communis by expression, sp. gr. .917. Solid at —12°; light yellow; very bland; in ointments and perfumery. Hager states that true oil of almonds when shaken in a test-tube with 25 per cent. of nitric acid forms a white emulsion-like mass, which remains white or faintly colored with yellow even when heated; while oil of peach kernels or apricots becomes yellowish at once, and depens to a reddish-yellow in half an hour.
Oleum sesami (benne oil).	From the seeds of Sesamum indicum and orientale.
Oleum arachidis (ground-nut oil).	From the kernels of fruit of Arachis hypogæa by expression, sp. gr. .918.
Oleum lini (flaxseed oil).	From the seed of Linum usitatissimum, sp. gr. .9347; its soaps are very soft; in liniments; rarely internally; much used in the arts.
Oleum behen (behen oil).	From the fruit of Moringa aptera; in ointments and pomades.

VEGETABLE OILS. (*Continued.*)

Oleum bertholetiæ (Brazil nut oil).	From kernels of fruit of B. excelsa, sp. gr. .917.
Oleum theobromæ (butter of cocoa, oil of chocolate nuts).	From roasted seeds of Theobroma cacao, sp. gr. .892. Solid at 80°. For ointments, suppositories, and soaps.
Oleum fagi (Beech oil).	From the fruit of Fagus sylvatica; very bland soap, soft; in Germany as a substitute for olive oil.
Oleum lauri (bayberry oil).	Expressed from the fruit of Laurus nobilis; green; butyraceous, granular very fragrant; taste bitter, aromatic; in ointment.
Oleum cocois (cocoa-nut oil).	From the kernel of the Cocos nucifera; white; of sweet taste; yields an excellent soap.
Oleum gossypii (cotton seed oil).	From the seeds of Gossypium herbaceum; refined, sp. gr. .921.
Oleum macidis (solid). Oil of mace.	From the arillus of the fruit of Myristica fragrans; resembles the next.
Oleum myristicæ.	Expressed from the nutmeg of Myristica fragrans; reddish; aromatic odor and taste; in ointment and perfumery.
Oleum palmæ (solid). Palm oil.	Obtained from the fruit of Elais guiniensis; orange-yellow; consistence of butter; agreeable odor; turns easily rancid.
Oleum papaveris (poppy oil).	From the seeds of Papaver somniferum, sp. gr. .9243; light yellow; nearly inodorous; is a drying oil used for culinary purposes, and as adulteration for olive oil.
Oleum ricini (castor oil).	From seeds of Ricinus communis, sp. gr. .9612; nearly colorless or yellowish; used as purgative.
Oleum tiglii (croton oil).	From the seeds of Croton tiglium, sp. gr. .947 to .953; light to dark yellow; readily soluble in alcohol; very acrid and drastic; blisters the skin.
Cera Japonica (Japan wax)	Said to be obtained from the fruit and leaves of Rhus succedanea; white; hard; fracture conchoidal.

2. ANIMAL OILS.

Adeps (lard).	Prepared fat of Sus scrofa, the hog.
Butyrum (butter).	From cream by mechanical agitation.
Sevum (mutton suet).	The prepared suet or fat, from Ovis aries.
Oleum adipis (lard oil).	The olein separated from lard by expression, sp. gr. .9003.
Oleum bubulum (neat's foot oil).	From the bones of Bos domesticus, the ox.
Oleum cetacei (spermaceti oil).	From the cavity in the upper jaw of Physeter macrocephalus.
Oleum Halicoræ (dugong oil).	From the Halicora dugong and Australis; recommended as a substitute for cod-liver oil.
Oleum morrhuæ (cod-liver oil).	From the livers of Gadus morrhua, sp. gr. .9230 to .9315.

3. ALLIED BODIES NOT CONTAINING GLYCERIN.

Cera flava (beeswax).	The substance used by the bees for constructing their cells; used in ointments, cerates, plasters, and in the arts.
Cera alba (white wax).	Beeswax bleached by the sunlight; used like the former.
Cera Chinensis (Chinese wax).	According to St. Julien, prepared by Coccus ceriferus, like beeswax; used in the arts.
Cera Myricæ.	Obtained by decocting the fruit in boiling water, and removing the wax when it has cooled.
Cetaceum (spermaceti).	In the head of Physeter macrocephalus; in ointments and the arts.

REMARKS ON THE FIXED OILS.

Of the foregoing list several are quite bland, agreeable, and destitute of active properties; of these *oleum sesami*, *oleum papaveris*, *oleum*

arachidis, *oleum cacao*, *oleum olivæ*, *oleum amygdalæ*, may be substituted for each other, and are adapted too for internal use.

Olive oil, of the finest quality met with in commerce, virgin oil, salad oil, has a pale yellow or greenish-yellow color, and a very faint and agreeable odor; its taste is bland and pleasant, though sometimes a little acrid; its specific gravity, at 77° F., is stated at .9109, .9176 at 59° F. It is soluble in one and a half times its weight of ether, but almost insoluble in alcohol; it generally contains a solid deposit of stearin and palmitin in cold weather, which is readily fused by a slight elevation of temperature. The best generally comes in bottles which hold from f℥xij to f℥xxiv, or in small flasks covered by wicker work, which, after they are emptied, come in play for small chemical operations. The common impure oil is generally rancid, acrid, and disagreeable, and often abounds in green coloring matter; it is obtained by expressing at an elevated temperature or by boiling the expressed residue with water and skimming off the oil.

The detection of adulterations in olive oil is a matter of no great difficulty to the connoisseur, as any admixture of inferior oils affects the taste perceptibly. The following are, however, more generally applicable.

Pure olive oil, when shaken in a vial half filled, gives a *bead* which rapidly disappears, but if adulterated the bubbles continue longer before they burst. Pure olive oil completely solidifies if immersed in ice, but if one-third of poppy oil is present it does not freeze at all at the temperature of ice. When carefully mixed with one-twelfth part of its volume of a solution of four ounces of mercury, in eight fluidounces and six drachms of nitric acid, sp. gr. 1.5, it becomes a firm fat in three or four hours, without any separation of liquid oil. The other edible oils do not solidify with acid nitrate of mercury, and the hardness of this mass is dependent on the purity of the oil. Animal oils solidify with this nitrate, but if olive oil is mixed with them it floats on the surface of the coagulum and may be decanted. And when heated this coagulum exhales the well-known odor of rancid fats. A few drops of it treated with a little nitric acid containing some nitrous acid readily solidifies, the oleic acid being converted into the solid isomeric elaic acid; if adulterated by a drying oil, it remains soft or solidifies much slower.

Pelouze has investigated the subject of the acidification of fixed oils, and confirms the fact already known, that foreign substances with which fatty bodies are contaminated exert an action upon them similar to that which a ferment exerts upon saccharine fluids, setting free fatty acids. He has also found that when oleaginous seeds are crushed so as to break up their cells and bring their contents into close contact, the neutral fatty bodies contained in them are spontaneously converted into fatty acids and glycerin. This phenomenon is analogous to what takes place in the grape, the apple, and other fruits, the sugar contained in which is converted into alcohol and carbonic acid as soon as the cells which separate it

from the ferment are destroyed. When extracted immediately, these oils are perfectly free from any traces of acid. The difference in quality between good and bad olive oil is thus explained, the former being extracted before the lapse of time has allowed of this peculiar fermentative action. Dr. R. C. Langlies adds to 3 parts of the oil to be tested, in a small flask, 1 part of nitric acid (prepared by mixing 3 parts acid, sp. gr. 1.33, and 1 part water), and heats in a water-bath; if the oil assumes a lighter color it is pure, if it becomes red the presence of oil from seeds may be considered certain.

Almond oil is procured from the kernels by expression, the best in our wholesale market being imported in jugs from England. Some few pharmacists in the United States have presses, with which they prepare this elegant product in great purity and perfection. It has about the specific gravity of olive oil, and is without its green tinge of color, so that it generally makes a whiter ointment. Almond oil is soluble in 25 parts of cold and 6 parts of boiling alcohol. In selling and prescribing it, care should be taken that it be not confounded with the essential oil of bitter almond. The name has been changed in the late edition of the *Pharmacopœia* to *Oleum Amygdalæ Dulcis.*

It is well known that some wholesale drug houses fraudulently substitute for this valuable oil, oil of poppy seed, which has little over half its money value; the fraud may be detected by mixing upon a glass or porcelain slab a few drops of the suspected oil with about an equal number of drops of nitric acid; the oil of poppies, being a drying oil, retains its fluidity, while the almond oil soon becomes hard.

Oil of Benne Seed.—Sesamum orientale has been produced in this country, and is recommended as a desirable production to add to our agricultural resources. The plant grows well, particularly in the South, and has been estimated to yield ten bushels of the seed to the acre; the yield of oil approaches two and a half gallons to the bushel. The seeds should be planted as soon as the frost is out of the ground in drills three feet apart, and six inches distance along the drills.

Poppy seed oil is imported in casks in considerable quantity from Germany, where it is frequently employed as a substitute for sweet oil for table use, and by some practitioners is preferred to oil of almonds. In this country it is made use of for the same purposes, and is besides often fraudulently substituted for or mixed with olive and almond oil, which see.

Oil of Groundnuts.—A fine oil is now extensively made both in France and in this country, by expressing groundnuts between hot plates in the same way that linseed oil is prepared. Its chief use, as far as I can learn, is to adulterate almond and olive oils. It is remarkably free from unpleasant properties, and if thrown into commerce under its own proper name, would no doubt answer many purposes in the arts, in medicine, and in domestic economy. Oil of groundnuts has been employed in place of neat's-foot oil for

citrine ointment, which, however, is apt to be too soft when thus prepared.

Oleum Theobromæ.—Cacao butter, the solid oil of chocolate nuts, softens, without quite fusing, at the temperature of the body; its odor and taste are peculiarly agreeable, and besides its application to chapped lips, its extensive use in suppositories, and its occasional employment as a coating to pills, it has been given internally as a substitute for cod-liver oil and other fats; it is liable to adulteration with solid animal fats, and I have met with specimens containing wax in considerable proportion. (A full account is given in the *Proc. Amer. Pharm. Assoc.*, xv. 347.)

Oleum adipis, *oleum lini*, *oleum bubulum*, *oleum bertholetiæ*, *oleum myristicæ expressum*, *oleum macidis*, *oleum cocois*, *oleum palmæ*, *oleum cetacei*, and *oleum gossipii*, are seldom used for any internal form of administration, but in common with olive and almond oil have their special adaptations and uses in the arts, and for topical applications in medicine.

Lard oil, which is a tolerably pure form of olein when freshly and skilfully prepared, is, however, seldom met with in commerce free from a disagreeable rancid odor; on this account it is rarely employed in medicine. It is said to be largely exported for fraudulent admixture with olive oil.

Linseed or flaxseed oil is chiefly used to mix with the carbonates of lead and zinc in the manufacture of the pigments known as white lead and zinc white; it is sometimes superseded for this use by a variety of inferior oils, which possess similar drying or oxidizing properties. Boiled linseed oil, particularly if litharge or acetate of lead is mixed with it in boiling, is remarkable for the rapidity with which it dries into a hard varnish-like material. This oil is sometimes used as a "healing" cathartic in doses of one or two ounces, for which purpose the cold expressed oil is preferable. In this dose it is highly recommended for piles, and for burns a liniment, made with liq. calcis, is used with admirable effect, and known in Scotland as carron oil from its frequent use at the Carron Iron Works.

Neat's-foot oil, as usually met with, is so offensive that it has been omitted from the one officinal preparation in which it was formerly directed—unguentum hydrargyri nitratis. It may be made pure and good enough for internal use, and in England it is said to be employed for frying fritters; it does not thicken by age.

Oil of brazil-nuts (oleum bertholetiæ), when properly made, is of a bright amber color, has the peculiar smell and taste of the nut, and congeals at 24° F. Dr. Donnelly, of Philadelphia, has used it as a substitute for olive oil in plasters and ointments, and found it to be well adapted for such purposes, one gallon of oil requiring six pounds of litharge to saponify, and yielding a good plaster of a rich cream color, and 12 oz. of a superior glycerin.

Expressed oil of nutmegs, as it occurs in commerce, is of the consistence of suet, and has a mixed white and yellow color, and a strong odor of nutmegs; it is prepared in the East India Islands by

exposing the bruised nutmegs contained in a bag to the vapors of boiling water and subjecting them to pressure between heated plates. It is entirely soluble in boiling ether; leaves nearly one-half behind on being treated with cold ether; the residue is white, pulverulent, inodorous. It is chiefly used for external applications where a mild stimulant is required.

Expressed oil of mace is now very seldom met with in commerce; it is prepared in a manner similar to the above, has the consistency of butter, a reddish color, and an agreeable strong odor and taste of mace.

Cocoa-nut oil is obtained by expression from the kernel of the cocoa-nut; it is of the consistence of suet between 40° and 50°, and semifluid between 75° and 85°; it is liable to have a peculiar odor owing to the presence of caprylic and capronic acids in small quantities, of which the greater part may be removed by digesting the oil for several hours with coarsely-powdered charcoal, and filtering through paper in a warm place. It has been proposed as a substitute for lard, especially in ointments which contain much vegetable matter, or aqueous mixtures, of which it is able by trituration to take up one-third more than lard. Its keeping well without getting rancid admirably adapts it for such purposes, and also for hair oil; it is readily absorbed by the skin, and, therefore, is not so apt to stain the garments and bedclothes. Burnett's cocoaine is understood to be chiefly composed of this oil.

Palm oil is consumed largely in the manufacture of soap, to which it imparts its peculiar odor and yellow color; of these, however, it is deprived by exposure to air and light. It is a very extensive article of commerce in England, entering into many of the cheaper varieties of soap, and in pharmacy being used in the manufacture of plasters, certain pomades and ointments, and in the manufacture of glycerin by distillation. It is a soft solid, melts at 117½° F., sp. gr. .968.

Spermaceti oil is the clearest and thinnest of the whale oils; it is remarkably adapted for greasing heavy machinery, for which purpose it is in great demand; it is also a fine oil for burning, but is rarely used in medicine or pharmacy, except by those few practitioners who believe it a good substitute for cod-liver oil.

Cotton-seed oil is obtained by expression as a very dark, almost black, tenacious oil, which, until the introduction of certain processes for its purification and bleaching, was deemed of no commercial value; it has since become a very large article of commerce, and is used in the arts for many of the purposes to which the bland fixed oils are applicable, and also for the adulteration of olive oil and the other more expensive oils. It has been used successfully in several officinal ointments. (See *Am. Journ. Pharm.*, 1861, p. 208.)

Oleum ricini, *oleum tiglii*, *oleum morrhuæ*, and *oleum halicoræ* are medicinal, and used as internal remedies.

Castor oil is a viscid, transparent, light yellow-colored oil, specific gravity .9575, at 77°. Its taste and smell, when of a fine quality,

are very slight, though its extreme viscidity renders it disagreeable. It is peculiar in being miscible with absolute alcohol in all proportions, and in rendering other oils, mixed with it in certain proportions, also soluble; it also dissolves some alcohol, but this property diminishes with the strength of the alcohol. The principal kinds found in the commerce of the United States are, the American oil, which is produced principally in the Western States and comes in casks; a variety said to be expressed principally in New York from seeds imported from the East Indies; and the East India oil, which is imported in tin cans from Bombay and Calcutta. The latter article is, I think, generally the best, either from the agitation to which it is subjected in the hold of the vessel during a long voyage, a great part of the time in the tropics, producing a separation of its albuminous ingredient, and thus clarifying it, or from some peculiarity in its preparation. A can of this oil is often found cloudy near the bottom, while the upper portion may sometimes be racked off remarkably clear and free from odor and taste.

The English castor oil, so much esteemed here, has been selected from the best East India oil and submitted to filtration, and afterwards bleached by exposure to the sun. The blue tinge of color of bottles in which it is sold, by neutralizing the yellow rays reflected from the oil, give it the appearance of great freedom from color. (*See* Pharmaceutical Notes of Travel, by the author, *Am. Journ. Pharm.*, vol. xxx. p. 114.)

The *Palma Christi*, which produces the valuable seed yielding this oil, is a beautiful annual plant, readily cultivated in our climate from the seed. It grows to the height of from six to ten feet, and is one of the most ornamental of annuals for garden or lawn.

The seeds are powerfully acrid and cathartic. The activity of these and the oil depends upon an acrid principle, said to be resinoid, which is invariably present in it, and is modified by the bland demulcent properties of the oil, rendering it one of the most useful of cathartics.

The leaves of *Palma Christi* have come into use within a few years as an application to the mammæ, with a view to promote the flow of milk; an extract prepared from them is spread upon cotton cloth and applied to the mammæ; an infusion is recommended for the same purpose, to be taken internally.

Great quantities of castor oil are consumed in the preparation of applications for the hair, it being now generally preferred to bear's oil, which was formerly much in vogue for this purpose. For greasing the hair, it should have a small admixture of alcohol to diminish its viscid properties, while for hair restoratives, such as are called katharion, tricopherous, etc., the alcohol is in larger proportion, the oil being added to diminish the drying and crisping properties of the spirits used. Recipes for preparations of this composition are given in the chapter on Perfumery and Toilet Preparations.

Croton oil, like the foregoing, is the product of the seeds of one of the family Euphorbiaceæ. It is imported in bottles holding

about twenty ounces. Its powerful irritant and drastic cathartic properties, in doses of from one to two drops, are well known. In applying it as a local irritant for producing a pustular eruption, it is usually diluted with twice the quantity of olive oil; it should then be carefully and conspicuously marked *for external use.*

Pure croton oil is soluble in about its own bulk of very strong alcohol, but in two or three days nearly all the oil separates. One of the most ready ways of testing its quality is to try its effect upon the skin; if pure, the speedy appearance of the eruption may be anticipated. (See *Amer. Journ. Pharm.*, 1860, p. 306.)

Dr. Isaac Hays, of Philadelphia, has often succeeded in producing the pustular eruption by mixing an equal bulk of oil of spearmint with croton oil when the pure oil failed to produce the desired effect.

Cod-liver oil, as supplied to the American market, is largely prepared upon our New England coast, and that of Newfoundland, in connection with the cod fisheries. Three different commercial varieties are produced, which vary in quality according to the skill and care expended in their preparation. *Pale* cod-liver oil is prepared in New England by cutting up the fresh livers and throwing them into water in a large tank arranged for the application of heat. A fire being kindled, the oil rises to the surface and is skimmed off; by standing, even after being barrelled, a deposit separates which allows of the clear oil being racked off. It is abundant in our markets within a few years, being used exclusively in medicine, and commanding a price, by the gallon, of from $2 to $3.

The other most common variety is the *dark-brown* oil. The livers, being thrown into a heap exposed to the sun, are thus allowed to become decomposed, and the oil is collected as it flows out from the corrupting mass. The dark-brown oil is rancid, having a disagreeable empyreumatic odor, and a taste which is bitter, besides being acrid, as in the other case. It is used extensively by curriers. Its price is usually about $1 per gallon.

The *pale-brown cod-liver oil* is intermediate in its properties between the foregoing; it is by some preferred to either, and by several customers with whom I have met is said to disagree less with the stomach. This variety is not so common in commerce. Many dealers do not procure it at all. I have obtained it by the gallon at from $1 25 to $1 75 per gallon. There are all grades of quality between the finest and commonest oils.

The large admixture of other fish than the cod in the produce of the New England fisheries, and the consequent admixture of the livers, has induced a very general opinion that the Newfoundland oil, as representing the oil of the livers of the cod exclusively, is to be preferred. This is the kind of oil sold chiefly in England, and upon which the reputation of the oil was mainly founded in the first instance. Excellent cod-liver oil is made in London from the livers of the fresh fish brought to that market. The firm of Allen and Hanburys supply their extensive demand from this source. The livers are placed in a large iron pan over a coal fire, and

heated to about 180° F., stirring constantly until they break down into a uniform pulpy liquid mass; this is immediately transferred to calico bags, whence the oil drains out. After filtration, while still warm, the oil is ready for use. In this state the oil separates, at the temperature of 60° F., a considerable deposit, which it is the practice of some to remove by filtration, while others allow it to remain as probably quite as efficient as the more fluid part.

The composition of cod-liver oil, as inferred from the analysis of Dr. De Jongh, is similar to that of other fatty oils, with the exception of a peculiar organic substance of biliary origin called by him *gaduin*, and also some of the constituents of bile, with traces of iodine, bromine, etc.

More recently, Dr. F. L. Winckler has investigated its chemical nature, and regards this oil as an organic whole of a peculiar chemical composition, differing from that of all other fatty oils hitherto employed as medicines. According to this eminent chemist, some glycerin is replaced by oxide of the organic radical *propyle* (C_3H), a compound of which exists also in ergot and in the liquor of pickled herring. From this Dr. Winckler infers that cod-liver oil cannot be replaced by any other officinal oil. Propylamine ($C_3H_7NH_2$), a product of the reaction of ammonia on cod-liver oil, is also found by Winckler in normal urine and sweat; and, viewing its formation as probable by the reaction in the system by which cod-liver oil is assimilated and burnt up in the lungs, he founds upon this his theory of the utility of cod-liver oil in medicine.

The amount of iodine in cod-liver oil does not exceed .05 per cent., and is too insignificant to be of great medicinal activity; sometimes other oils have been substituted for it by dissolving iodine in them. True liver oils all give Pettenkofer's reaction; a drop of sulphuric acid produces a violet color with the biliary constituents contained in the oil.

Dugong Oil.—This oil is obtained from two herbivorous cetaceous animals, the family Manitidæ, the one, Halicore Dugong, an inhabitant of the Indian Seas, the other, Halicore Australis, occurring off the northwest coast of Australia. Specimens of this oil from Ceylon are solid, while from Australia more fluid, though with a deposit of stearin. Both have a tallow-like taste and no fishy smell, and have been used as substitutes for cod-liver oil. I am not aware that any specimens have reached the United States as yet.

In addition to the foregoing, no less than thirty-seven fixed oils and fats are found in the shops of the various nations of Europe, many of which were formerly officinal. Some of these are now called for by the more ignorant classes under the impression that special virtues attach to the fats of different animals and fishes. *Goose grease* is much esteemed as an application to chapped hands, and to be applied by inunction for rheumatic and other pains; it is preserved in many families for this use. *Bear's oil* has a great reputation for the hair, and is undoubtedly a good application and less

liable to become rancid than some other oils. It is met with in considerable quantities in the western cities, but it is needless to remark that very few of the hair preparations labelled bear's oil are even contaminated with this ingredient. *Catfish oil*, *sturgeon's oil*, *porpoise oil*, and *rabbit fat* are all occasionally in demand, but seldom kept by the druggist or pharmacist; it is within the recollection of the writer that cod-liver was equally a *rara avis*.

CHAPTER VI.

ON VOLATILE OILS, CAMPHORS, AND RESINS.

Volatile or Essential Oils.

This important and interesting class of proximate principles contains an immense number of individuals which are distinguished from each other more by striking sensible and physical than by chemical peculiarities. By far the largest number are derived from plants, in which they exist ready formed, although some are the products of a spontaneous fermentative action set up among principles contained in the plants in the presence of water. Volatile oily products of the destructive distillation of organic substances, the rational composition of which is not known, are likewise conveniently classed with volatile oils. Those which may be designated as definite chemical compounds, such as creasote, may be more appropriately treated of under the head of the several sources from which derived. Natural volatile oils are mostly prepared by mixing plants or parts of plants containing them, with water, and, after maceration for a certain length of time, subjecting the mixture to distillation. The distillate is usually milky, and on standing separates, most of the oil rising to the top, or, in a few instances, subsiding, while the water continues charged to saturation with the oil. Although the boiling point of these oils is much above that of water, most of them are readily volatilized in contact with steam at 212°, and are hence conveniently prepared by distillation as above.

The unpleasant odor at first perceived in the distillate was formerly believed to be empyreumatic, but is now said to be due to portions of tin dissolved from the neck of the still or the condensing worm, and to disappear with the subsequent oxidation of this metal, and its separation as a flocculent precipitate; this is often mistaken for an algæric vegetation.

Some highly odoriferous plants, which yield by this process sparse and unsatisfactory results, are found to impart their volatile oils better by digestion with fixed fatty bodies, which, when treated with strong alcohol, yield the volatile oils to that solvent, forming

essences; numerous oils or essences used in perfumery are prepared in this way. Others are prepared by direct expression from the structures containing them, as the oils obtained from the rind of the lemon and bergamot fruits; while others are obtained, with associated resins and camphors, by the use of ether; in the *Pharmacopœia* several of these are grouped under the head Oleoresina.

The volatile oils are mostly soluble in water to a very limited extent; and dissolve a small proportion of water, which separates at low temperatures. They are mostly soluble to an unlimited extent in anhydrous alcohol, ether, and the fixed oils.

The perfume of most plants is due to the gradual elimination, diffusion, and oxidation, in very minute quantities, of their volatile oils. Every one must have noticed that in the moist morning and evening atmosphere, the odor of flowers is greatly enhanced, a phenomenon which is partly due to the power of vapor of water to aid in the diffusion of the volatilized oils, and probably partly to an increased tendency to oxidization in contact with aqueous vapor. According to Liebig, the perfume of essential oils is strong in proportion to their tendency to oxidize in the air, though their degree of volatility has also an important bearing on this property. Their odor is generally strong in proportion to the oxygen in their composition. Certain oils containing no oxygen may be temporarily deprived of their characteristic odors by distillation from freshly-burnt lime in an apparatus exhausted of air or filled with carbonic acid gas. The odor of essential oils is apt to be less delicate or grateful after they have been isolated than when spontaneously exhaled by the plant, and by time and exposure many of them not only lose their delicacy of flavor, but become less limpid, assuming a darker color and more resinoid consistence. In the process of drying certain plants at a moderate heat, the oil seems to improve in flavor, while very little of it is dissipated, so that the aromatic seeds, as of fennel and caraway, the unexpanded flowers of cloves, etc., as found in commerce, yield full proportions of essential oils, and of finer quality than the imported oils obtained from them when fresh. Valerian is an instance of the smell being greatly increased by age, owing to the oxidation of the oil.

In judging of the odor of a volatile oil the diffusion of a very small quantity in the air is preferable to applying the nose directly to the vial. Inexperienced persons will sometimes fail to recognize the resemblance of the oil or essence to the plant from which derived from neglect of this; a drop rubbed upon the hand and moistened by the breath will generally develop the characteristic odor. Solutions of essential oils in alcohol often disappoint the expectation of amateurs from the predominance of the odor of the spirit, which, as the most volatile ingredient, first salutes the olfactory nerve; and yet these solutions may be suited to the purposes in view, imparting a lasting perfume after the alcohol has evaporated. It is the custom of perfumers to dilute the alcoholic solutions of essential oils, colognes, toilet waters, and spirits, with as large a proportion of water as is compatible with the complete

solution of the oil. (*See* chapter on Distilled Products and Perfumery.)

In medicine, the essential oils, as existing naturally in plants and extracted by menstrua, or as isolated for separate use, are in the highest degree useful and important; they and their immediate derivatives, the camphors and resins, furnish remedies of the following therapeutic classes: stimulants, arterial and nervous—in the latter class the sulphuretted oils are especially important—rubefacients, carminatives, emmenagogues, parturients, diuretics, anthelmintics, sedatives, and a few of them are used with great advantage as remedies in hemorrhages and for important alterative effects in the secretions. The most familiar use made of volatile oils in ordinary prescriptions is with reference to their aromatic and corrective properties in combination with other remedies. Upon their employment in this connection, *see* chapter on the Art of Prescribing.

Chemical History.—Notwithstanding the admitted crude and imperfect preparation of the volatile oils of commerce, and the fact that they consist of different proximate principles varying in their relative proportions to each other, and therefore in the results of their analyses; yet much light has been thrown upon their chemical history by the labors of chemists.

Volatile oils may be classed as, 1. Carbo-hydrogens or camphenes; 2. Oxygenated oils; 3. Nitrogenated oils; 4. Sulphuretted oils; and 5. Empyreumatic oils. Another classification, by Fourcroy, is, 1. Fugacious oils, obtainable only by the "intermediary" of a fixed oil, such as lily, jasmine, tuberose, etc.; 2. Light oils, those extracted by expression; 3. Viscous oils, such as canella, cloves, cardamom, etc.; 4. Concrete oils, extracted by distillation, which solidify on cooling or crystallize by slow evaporation; 5. Cerates, or those extracted in a concrete state by expression, as nutmeg oil; 6. Camphorated oils, those from which a substance similar to camphor can be extracted, as lavender, rosemary, etc.

The natural volatile oils belonging to the first class all have the composition $C_{10}H_{16}$, and from nearly all of the second class by fractional distillation a liquid of the same composition may be obtained, having, with few exceptions, a lower boiling point and being thinner and of less specific gravity than that portion distilling at a higher temperature; the former is called *elæopten;* the latter, *stearopten;* it usually contains oxygen, and frequently has the composition of ordinary camphor, $C_{10}H_{16}O$, oxide of camphene; or its composition corresponds with a hydrate of camphene, $C_{10}H_{18}O$ (Borneo camphor), $C_{10}H_{20}O_2$ (juniper camphor), $C_{10}H_{22}O_3$ (lemon camphor). A similar hydrate may be obtained from turpentine and most other camphenes by treating them with a mixture of nitric acid and alcohol, when *terpin*, $C_{10}H_{16}+6H_2O$, crystallizes, which in vacuo loses $2H_2O$.

By the action of hydrochloric acid gas on the camphenes, a combination of the two is effected, which may be liquid or solid; if the latter, it is crystalline, and from its resemblance to camphor has been called artificial camphor. The behavior of a number of the

camphenes towards polarized light has been observed; most of them deviate its plane to the left; the carbo-hydrogen of oil of lemon is an exception, turning the polarized light towards the right.

All *pure* volatile oils are believed to be colorless, though a few have not as yet been obtained entirely destitute of color, while a few are so readily influenced by air and light, as, after rectification, to assume coloration in a short time (oil of cinnamon and cassia). There are very few colored oils which cannot be freed from color by rectification or fractional distillation; oleum matricariæ and anthemidis have a blue color; oleum millefolii an indigo blue; oleum absinthii a deep-brown color; oleum sem. nigellæ, which is of a brownish color, has the property of fluorescencing with a blue color, which may also be observed in its alcoholic and ethereal solutions.

The volatile oils, by absorbing oxygen from the atmosphere, assume a deeper color, which passes through yellow, reddish, or greenish, to brown; those to which a color naturally belongs also undergo this change, generally passing through green to brown. This change, as a general rule, takes place very slowly with the natural carbo-hydrogens; oxygenated oils change more quickly, usually in proportion to the oxygen they contain. With the deepening of the color, the fluidity of the volatile oils is lessened owing to a resinification taking place, some gradually assuming the consistence of resins; at the same time the odor is altered and rendered more or less unpleasant.

The less stearopten oils contain, the less are they influenced by change of temperature, while from all a few crystals may be obtained in the cold, unless they have been entirely deprived of the water dissolved by them in minute quantities during their preparation. As the carbo-hydrogens are not solidified by a low temperature, a change in the amount of the stearopten must necessarily alter the freezing and melting points of the volatile oils, the latter of which is always several degrees above the former. G. H. Zeller, from his own observations with oils prepared by himself, gives the following:—

Oleum	anisi	solidifies at	43°	to	66°	F.,	liquefies at	68°	to 72° F.
"	" stellati	"	" 54	"	59	"	"	" 63.5	"
"	arnicæ flor.	"					"	" 100	"
"	fœniculi (mostly elæopten)	"	bel.+5			"	"	" 21	"
"	" (rich in stearopt.)	"	at 41	"	45	"			
"	matricariæ	"	" 10	"	5	"	"	" 21	"
"	petroselini	"	" 36	"	50	"			
"	rosæ geran	"	" 88				"	" 100	"

The boiling point is variable from the same cause; volatile oils commence to boil at comparatively low temperatures, when elæopten with little stearopten distils over; gradually the boiling point rises and the distillates contain more of the stearopten; the boiling point of any pure compound of the volatile oils is stationary.

The relations between certain essential oils, organic acids, and neutral principles found in plants, constituting regular series of chemical compounds, though not as yet discovered to extend to

any great number of them, are among the most curious and interesting developments of modern chemistry. The following syllabus embraces most of these:—

Benzyle, Bz	$C_{14}H_{10}O_2$
Hydruret of Bz, oil of bitter almond	C_7H_6O
Oxide of Bz, anhydrous benzoic acid	$C_7H_6O_2$
" crystallized "	$C_7H_6O_2+HO$
Cynnamyle, Ci	C_9H_8O
Hydruret of Ci, oil of cinnamon	C_9H_9O
Oxide of Ci, cinnamic acid	$C_9H_8O_2$
Cumyle	$C_{10}H_{11}O$
Hydruret of cumyle, oil of cumin	$C_{10}H_{12}O$
Oxide of cumyle, cuminic acid	$C_{10}H_{12}O_2$
Thymyle, Th	$C_{10}H_{13}$
Hydruret of Th, thymene	$C_{10}H_{14}$
Oxide of Th, thymol	$C_{10}H_{14}O$
"Carvol," oil of caraway	$C_{10}H_{14}O$
"Carvacrol," creasote of camphor	$C_{10}H_{14}O$
Rutyle, Rut	$C_{10}H_{19}O$
Hydruret of Rut, oil of rue	$C_{10}H_{20}O$ *
Salicyle, Sal	$C_7H_5O_2$
Hydruret of Sal (spirous acid)†	HC_7H_5O
Helicin + aq.	$C_7H_6O_2+C_6H_{12}O_6$ (glucose)
Saligenin	$C_7H_8O_2$
Salicin + 2 aq.	$C_{13}H_{18}O_7$
Salicylic acid	$C_7H_6O_3$
Salicilate of oxide of methyle, oil of gaultheria	$CH_3C_7H_5O_3$

Adulterations and Tests.

Essential oils are liable to be adulterated with fixed oils, with alcohol, and with other and cheaper essential oils. The mode of detecting these adulterations is as follows:—

With Fixed Oils.—Oils thus adulterated leave upon bibulous paper a greasy spot, which remains even after long-continued heating over the flame of a lamp. Sometimes, owing to the essential oil being partially resinified, it leaves a mark which is devoid of transparency and possesses a peculiar gloss, while the stain from a fixed oil is transparent, and, when completely absorbed by the paper, devoid of a distinct gloss—besides, when soaked in alcohol and heated, the resinous stain can be wiped off, while the fatty stain cannot be removed. When a mixture of volatile and fixed oils is distilled with water, the volatile oil passes over while the fixed oil remains, and may be saponified with alkali. On dissolving the volatile oil in strong alcohol, in the proportion indicated in the syllabus, the greater part of the fixed oil remains undissolved. Small proportions of fixed oils may escape detection if soluble to any extent in alcohol, and this difficulty is increased by the increased solubility of the fixed oils from admixture with essential oils.

With Alcohol.—When the proportion of alcohol is considerable, the greater part of it may be extracted by water, the liquid becoming turbid, and the oil finally separating. When the quantity of the adulteration is small, it is better to shake it with olive oil,

* The aldehyde of caprinic acid. † Oil of spiræa (*see* Acids).

which dissolves the essential oil, and separates the alcohol in a layer floating on the surface. The quantity of alcohol is shown *approximately* by shaking the adulterated oil with an equal bulk of water in a minim measure or test-tube graduated for the purpose, and observing the diminution of its volume. Into a graduated tube, two-thirds filled with the oil, some pieces of chloride of calcium may be introduced, and a gentle heat applied for a few minutes with agitation. If no alcohol is present, the lumps of chloride of calcium appear unaltered on cooling; if it contains alcohol, they will show a disposition to coalesce, and if it is in considerable proportion, a fluid layer will separate at the bottom, on which the oil will float. This is especially applicable to oil of lemon, of which 480 grains, mixed with 15 of alcohol, liquefies 3 grains of chloride of calcium. The suspected oil being agitated with dry acetate of potassium, if dissolved, on mixture with sulphuric acid, and heating, the odor of acetic ether is evolved, recognizable by its odor. Nitric acid, added to oil of bitter almonds, will only give off nitrous fumes in case of its adulteration with alcohol.

With other Essential Oils.—One means of detecting these common adulterations is by rubbing a small quantity upon the hand and noticing the odor before and after it is dried, or in setting fire to a small portion and blowing it out again, when the foreign odor may generally be perceived. If, on agitating the suspected oil with its own bulk of strong alcohol, it is not completely dissolved, probably oil of turpentine, or some other sparingly soluble oil, is present. Most carbo-hydrogens require over 10 parts of alcohol, of .85 sp. gr., to dissolve them. Oil of savine is soluble in 2 parts of alcohol of this strength, which affords a means of detecting its adulteration by the oil of turpentine.

Oils of copaiba, cubebs, and the empyreumatic oils, are recognized by the absence of a violent fulminating reaction with iodine.

The natural carbo-hydrogens prevent the reaction of the oxygenated oils with a proportionate amount of nitroprusside of copper, which must, therefore, be used in very small quantity only.

This reagent is prepared, according to Wittstein, by the following process: 10 ounces nitric acid, sp. gr. 1.20, are stirred into 4 ounces powdered ferrocyanuret of potassium, afterwards digested on a water-bath until the filtered solution is precipitated with a slate-color by a protosalt of iron; the liquid is then diluted with twice its measure of water, neutralized with carbonate of sodium, heated to the boiling point, filtered, and precipitated with sulphate of copper; the precipitate is well washed and dried at a moderate heat.

The color imparted to oxygenated oils, so far as examined, is characteristic and striking: For ol. cajeputi viride, olive-green; ol. caryoph., pink, violet, cherry-red, reddish-brown, opaque; ol. cassiæ, hyacinthine, deep brown, red; ol. chenopodii, instantly brown, red; ol. millefolii, pale blue, dark green; ol. monardæ, colorless, green, brown, black; ol. myrciæ, greenish, greenish-brown to

brown-black. The others are yellow or brown, combined with yellow and red. (See *Proceed. Am. Pharm. Asso.*, 1858, p. 344.)

Nitric acid reacts energetically with but few volatile oils, unless heat be applied, but oxidizes them slowly. The binary essential oils are converted into a hard or brittle resin, with the exception of oleum sabinæ, which yields merely a liquid of about the consistence of olive oil. The oxygenated oils, on the other hand, are usually converted into a thick liquid or soft resinous mass; ol. absinthii, aurantii corticis, calami, cari, caryophylli, cassiæ, matricariæ, menthæ crispæ, origani vulgaris, petroselini, and valerianæ yield with this reagent, without the application of heat, hard and even brittle resin, in some instances with the evolution of vapors of HNO_2.

Sulphuric acid produces with but few volatile oils any characteristic reaction; it usually renders them more consistent; but converts them very rarely into a dark resin; the color of the acid, after the reaction has ceased, is generally of various shades of brown or reddish-brown.

The color of the following oils is finally changed to blue or violet by H_2SO_4, ol. absinthii, caryophylli, and valerianæ; to olive-green, ol. cinnamomi Chinens.; to blood-red, ol. anisi stellati, origani vulg., and petroselini; to carmine red or purple, ol. cinnamomi Ceylon, cumini, fœniculi, majoranæ, salviæ, serpylli, and thymi.

The sulphuric acid turns to a pure red, blood-red, or purple color, with ol. anisi, anisi stellati, calami, cassiæ, fœniculi, macidis, and serpylli.

Iodine applied in fine powder reacts very differently with the various essential oils, but this reaction is greatly modified by their age, being generally less energetic in proportion to their resinification and with the diminution of temperature, so that different results are obtained at our medium summer heat, and in winter at the moderate temperature at which our rooms are usually maintained.

The binary oils are fulminating in a high degree with iodine, except ol. copaibæ, cubebæ, and elemi, which are but moderately acted upon. Of the oxygenated oils, those of the Aurantiaceæ fulminate with iodine; also ol. lavandulæ, macidis, origani vulg., petroselini, and spicæ.

Ethereal solution of iodine exerts, as a general rule, a less powerful action upon the volatile oils than iodine in substance.

Bromine fulminates with many oils most violently; the reaction is frequently so forcible as to throw out of the vessel most of its contents. An ethereal solution of bromine is better adapted for this purpose, because the reaction with the oils is sufficiently slow to notice any changes in their color and consistency. (See *Proceed. Am. Pharm. Asso.*, 1858, p. 344, and 1859, p. 338, where this subject is fully treated of by Prof. J. M. Maisch.)

In examining volatile oils for their purity, it is advisable to take into consideration all their physical properties and their behavior with various reagents; the greater or smaller amount of either

stearopten or elæopten will modify, to a certain extent, their physical and chemical properties. The preservation of the volatile oils free from alteration by time seems to be facilitated by keeping them well secured in small bottles secluded from the light, and by the addition of alcohol even in small proportion. Carl Früh recommends the following method for oils of lemon and orange: to every pound of the oil one ounce of alcohol is added and well mixed, then an ounce of water is added, which withdraws the alcohol from the oil and collects at the bottom as diluted alcohol, separating a resinous film.

To restore old and resinified volatile oils Curieux recommends a strong solution of borax, which is mixed with animal charcoal, and then agitated with the oil; the latter separates free from resin, and with the original odor. For large quantities the simplest process is, probably, redistillation with water, and sometimes with a little alkali.

A process successfully applied by Charles Bullock, of Philadelphia, to oil of lemon consisted of mixing the oil with a solution of permanganate of potassium, in the proportion of an ounce of the salt to eight ounces of water; this quantity is sufficient for four pounds of the oil. The mixed oil and solution being agitated together for a long time, the oil was decanted, mixed with fresh water, and warmed gently till it floated perfectly clear on the surface.

Class 1st.—Carbo-Hydrogen Essential Oils.

The most simple essential oils are those which consist of carbon and hydrogen alone. Some of these are frequently associated with the oxygenated essential oils. The coniferæ, leguminosæ, and piperaceæ yield nearly all that are known. Although these are so similar in composition, they are as dissimilar in many of their properties as they are unlike the members of the oxygenated group. As already stated, when absolutely pure and exposed to no oxidizing influences, they are quite inodorous, and it is impossible in this state to distinguish oil of lemon from oil of turpentine, or oil of juniper from oil of neroli. As soon as they are exposed to ordinary external influences, however, they develop their characteristic odors and become less limpid and free from color. Left in contact with about an equal volume of alcohol and one part of nitric acid, they gradually absorb water and separate an indifferent crystallizable hydrate, which has been called *terpin*. By nitric acid they are converted into hard resins, and sulphuric acid colors them, mostly of various shades of red; nearly all fulminate with iodine, or like the oils of cubebs and elemi evolve at least vapors. With hydrochloric acid gas they yield either solid or liquid compounds. As a class, they are the least soluble in alcohol and in water, and have the lowest specific gravity. Several of them are among the most useful of vegetable stimulants. The composition of the carbo-hydrogen essential oils is $C_{10}H_{16}$, or some multiple of C_5H_8; they

are therefore called terebenes or camphenes, and may be regarded as the radical of camphor, as the following table shows:—

Camphene . . .	$C_{10}H_{16}$	Camphor from Camphora officinarum	$C_{10}H_{16}O$
Borneo camphor . .	$C_{10}H_{16}H_2O$	Camphoric acid . . .	$C_{10}H_{16}O_4$
Terpin (Juniper camphor)	$C_{10}H_{16}2H_2O$		
Lemon camphor . .	$C_{10}H_{16}3H_2O$		

Syllabus of Empyreumatic Volatile Oils.

1. Composition $C_{10}H_{16}$.

Caoutchine, from caoutchouc.	Boils at 340°; odor resembling lemon; taste burning, aromatic; sp. gr. .842.
Colophene, rosin oil, from rosin.	Colorless in transmitted, indigo-blue by reflected light; sp. gr. .940; boils at 600°; odor peculiar, empyreumatic; used in painting.
Ol. asphalti, from asphaltum.	Contains two isomeric compounds; cold HNO_3 colors it brown.
Ol. betulæ, from bark of Betula alba.	Odor agreeably terebinthinate; sp. gr. .847.
Ol. succini, from amber.	Yellow, sp. gr. .80 to .88; odor empyreumatic; used as antispasmodic internally and externally; contains several isomeric oils; with 6 parts fuming HNO_3 yields artificial musk; formerly often employed as a substitute for musk.

2. Composition C_nH_n.

Oleum petræ, petroleum.	From springs in coal regions; colorless and thin; yellow, brown, and almost black, and thick oily; the American coal oil, kerosene, belongs to this class, as well as Barbadoes tar; consists of numerous isomeric oils.
Paraffinum, paraffin.	Crystalline, inodorous, and tasteless; possesses little affinity for chemical reagents; fusing point varies from 91° to 149°; stoppers rubbed with it do not adhere to neck of bottles containing alkalies.

3. Composition various.

Oleum cadinum, from the wood of Juniper oxycedrus.	Used in Greece for chronic eruptions on the skin, in the form of plasma, etc.
Eupion.	Colorless, aromatic, indifferent, boils at 110°; isomeric bodies of composition C_nH_{n+2}; accompanies creasote.
Chysene C_6H_4	Golden-yellow, crystalline, in coal tar.
Pyrene $C_{15}H_{12}$	Colorless microscopic needles, in coal tar.
Photagene.	From the tar of turf, bituminous coal, etc.; colorless, thin, of great illuminating power; with HNO_3 nitro-benzole and other nitrogenated compounds.
Naphthalin $C_{10}H_8$	In coal tar, soot, etc.; colorless rhombic laminæ, slightly aromatic, fusible at 175°.

So far as examined, these carbo-hydrogens are not altered in appearance on being boiled with nitro-prusside of copper, a reagent before adverted to as of much interest in connection with the oxygenated essential oils; they even have the power to prevent a certain quantity of this body from acting on the oxygenated oils.

Notwithstanding their isomerism, their odor, boiling point, and optical behavior vary considerably. It is frequently only by the last two means that we are enabled to conclude on the purity of these volatile oils. Berthelot has shown that by the fractional distillation of ordinary oil of turpentine different portions may be obtained, being alike in odor and composition, but having a somewhat different boiling point, deviating polarized light with a dif-

ferent degree, and entering with hydrochloric acid into combinations of a slightly different character.

The following syllabus contains those binary oils which are obtained as such directly from the plants, or merely by a simple rectification of the crude product.

Syllabus of Plants yielding Carbo-Hydrogen Essential Oils.

Dipteraceæ.	
Dryobalanops camphora, Borneo camphor tree. In the cavities of the trunk.	Oleum camphoræ, sp. gr. .92 to .945: the natural oil contains camphors; solid with HCl.
Terebinthaceæ.	
Amyris elemifera, Elemi tree—oleoresin.	Ol. elemi; yield 13 per cent.; colorless; sp. gr. .852; odor agreeable, terebinthinate; with HCl a liquid and solid compound.
Balsamodendron myrrha, myrrh—gum resin.	Ol. myrrhæ; yield 2 to 2¼ per cent.; colorless or yellowish; taste aromatic camphoraceous; used in toothache.
Boswellia serrata, East India Olibanum tree—gum resin.	Ol. Olibani; yield 4 to 5 per cent.; colorless; sp. gr. .866; odor terebinthinate; contains very little O; explodes when heated with HNO_3.
Hedwigia balsamifera, Mountain balsam—oleoresin.	Ol. Hedwigiæ; yield 11 per cent.; yellowish; odor terebinthinate; by HNO_2, flesh-colored and carmine.
Leguminosæ.	
Copaifera (various species)—oleoresin.	Ol. Copaibæ; yield 40 to 80 per cent.; colorless; sp. gr. .87 to .91; with 20 to 30 p. alcohol a turbid solution; $C_{10}H_{16} + 2HCl$ solid; yields terpin slowly; fulminates slightly with I.
Piperaceæ.	
Piper cubeba, cubeb—fruit.	Ol. cubebæ; yield 5 to 15.5 per cent.; colorless; sp. gr. .92 to .93; with 27 alcohol opalescent; with I yellow and gray vapors; by H_2SO_4, brownred.
Piper nigra, black pepper—fruit.	Ol. Piperis nigræ; yield 1 to 3 per cent.; sp. gr. .86 to .89; no solid compound with HCl.
Coniferæ.	
Abies canadensis, hemlock spruce fir—boughs.	Oil of hemlock or spruce; yield 1 oz. per 8 lb. See *Am. Journ. Ph.*, 1859, 29.
Juniperus communis, juniper—fruit, tops, and wood.	Ol. Juniperi; yield of fruit ½ to 2½ per cent.; colorless; sp. gr. .85 to .91; $3C_{10}H_{16} + 2HCl$ is liquid; yields terpin very slowly; with 12 p. alcohol turbid; very fulminating with I.
Juniperus sabina, savin—leaves.	Ol. sabinæ; yield 1 to 5 per cent.; colorless; sp. gr. .89 to .94; soluble in 2 p. alcohol, with more opalescent; compound with HCl not solid; yields terpin after several months; with HNO_3 thin balsam; with I very fulminating.
Juniperis Virginiana, Red cedar—leaves.	Ol. Juniperi Virginianæ; colorless; soluble in 1 p. alcohol, turbid with 2½ p. alcohol and more; dissolves I without reaction.
Pinus pumilio, Mountain pine—oleoresin.	Ol. templinum; colorless or pale yellow; sp. gr. .85; turbid with 10 p. alcohol.
Pinus palustris and other species of pine—oleoresin.	Ol. terebinthinæ; colorless; sp. gr. .86 to .90; clear solution with 10 to 12 parts alcohol; fulminates violently with I; with HCl a solid and liquid compound.
Pinus sabiniana.	Abietine; sp. gr. .594 at 61.7° F.; boils at 214° F. For removing paint, grease, etc.; peculiar in being lighter than alcohol or ether.
	The leaves of various species of Pinus yield a volatile oil containing $C_{10}H_{16}$ and oxygenated compounds.

Class 2d.—Oxygenated Oils.

Besides carbon and hydrogen, these essential oils contain oxygen, either in both the elæopten and stearopten or only in the latter. The elæopten is usually a carbo-hydrogen, and then mostly of the composition $C_{10}H_{16}$; it is but rare that the stearopten, or camphor as it has been called, as in the case of oil of rose, is a carbo-hydrogen. Many important members of this class are obtained from the natural families Umbelliferæ, Labiatæ, Lauraceæ, and Compositæ, but they are very widely diffused in other divisions of the vegetable kingdom. In some instances oils belonging to different groups are obtained from different parts of the same plant; thus the oils obtained by distilling the oleoresinous exudations of the Coniferæ are carbo-hydrogens, while the leaves and young branches by distillation with water frequently yield different volatile oils containing oxygen; the oils from the leaves, bark, and fruit of several species of Rosaceæ contain hydrocyanic acid, and possess decidedly sedative and even poisonous properties, while the flowers of the same plants and all parts of the herbaceous Rosaceæ are destitute of any volatile nitrogenized principle.

Of the complex series derived chiefly from the Cruciferæ, and containing sulphur, one only, that of garlic, numbers oxygen among its elements. Only three of the oxygenated oils, those of cinnamon, gaultheria, and bitter almond, have as yet been produced by chemical processes from other vegetable principles. This extraordinary attainment of modern chemistry leads to the inference that many others of this class are capable of artificial production.

Being composed of two or more different liquids, their formulas should give the composition of these compounds; many, however, are little known. The empirical formulæ will never convey a correct idea of the composition of these oils, inasmuch as each individual oil varies much when obtained from fresh or dried plants, from plants grown in a rich or poor soil, and even collected in different seasons; the stearopten, the oxygenated part, varies so much in quantity or proportion as to sensibly affect the specific gravity, the boiling point, as well as the freezing and melting point; all these characters, when given of an oil, belong to a particular one, and may be modified in another oil of like purity.

With the action of reagents, for the same reasons, there are certain final results, nearly alike for the same pure oil, differing though it may in the proportion of its components, or in the degree of its oxidation; the intermediate changes by a reagent from the pure rectified oil to the final result, which are sometimes interesting and characteristic, may be lost or greatly modified on account of the resinification.

The oxygenated volatile oils, though heavier than the carbo-hydrogens, are, with a few exceptions, lighter than water; their specific gravity ranges from .82 to 1.09. (*See* Chemical History, etc.)

The oxygenated oils, like the carbo-hydrogens, are mostly local and general stimulants: some of them are of the kind called car-

minatives, used to expel wind in colic; others are stomachics, promoters of digestion; a few, from their influence upon the nervous centres, rank as antispasmodics. Not a few are chiefly valued as perfumes, whether for the toilet or in pharmacy.

Most of the spices, as nutmeg, mace, pimento, cloves, contain oxygenated oils, which, in connection with peculiar camphoraceous or resinous ingredients, give them their value as condiments or seasoners.

The herbs used in soups and stuffings, and rendering savory many otherwise tasteless dishes, all contain essential oils, and most of them of this series. It will be observed that none of the essential oils rank as narcotics, except in overdoses, though those of camphor, valerian, serpentaria, etc., as before stated, are used as cerebro-spinal stimulants and antispasmodics; the peculiar oil of tea (Thea Bohea) is probably concerned in producing its agreeable exhilarant effects.

As a class of essential oils, the oxygenized are the most soluble in alcohol and water, and enter into the *Aquæ* (*Medicatæ*) and *Spiritus* introduced among the Galenical preparations.

In the following syllabus, all the oxygenated oils will be found under the heads of their respective plants, arranged in systematic order, together with their most striking characteristics and uses.

Syllabus of Plants Yielding Oxygenated Oils, etc.

(Mostly dicotyledons, but few monocotyledons.)

Dicotyledons.		
Ranunculaceæ.		
Nigella sativa—small fennel flower	seed	16 oz. yield 4 scr.; pure oil is opalescent; dissolves in 30 p. alc.; HNO_3 with heat and H_2SO_4 color violet.
Magnoliaceæ.		
Drimys Winteri—Winter's bark	bark	16 oz. yield 10 to 20 grs.
Illicium anisatum—Star anise	seed	$C_{10}H_{16}$ and $C_{20}H_{12}O_2$; the latter solid below 50°, melts at 62°, boils at 430°. (*See* Umbelliferæ.) Sold for oil of anise; yield 1.5 to 3.5 per cent.; sp. gr. .97 to .98; soluble in 5 alcohol.
Anonaceæ.		
Unona odoratissima—Ihlang-ihlang	.....	Ihlang-ihlang. Distilled in Manilla and Singapore; used in perfumery; very costly; odor resembling jessamine and lilac, but sui generis. Rissemel.
Resedaceæ.		
Reseda odorata—Mignonette	flowers	Very minute; extracted by a fat oil for use in perfumery.
Violaceæ.		
Viola odorata—Sweet violet	"	Blue; delightful fragrance; yield very small; for use in perfumery extracted by a fixed oil.
Tiliaceæ.		
Tilia Europæa—European linden	"	Yield exceedingly small; oil thin, colorless, very fragrant.

Aurantiaceæ.		
Citrus aurantium—Sweet orange " limetta—Bergamot lemon " limonum—Lemon " lumia " medica—Citron " vulgaris—Seville orange	leaves, flowers, and peel of fruit	The oil obtained from orange leaves is called *essence de petit grain;* that from the flowers of Citrus vulgaris is the real *oil of neroli,* though probably the flowers of other species are mixed with them before distillation; oil from the peel is mostly $C_{10}H_{16}$; all contain $C_{10}H_{18}O_2$. Their sp. gr. is between .82 and .90, and they all fulminate with iodine. *Ol. aurantii flor.* yield from fresh flowers 2 to 4 per cent.; soluble in 1 to 3 alcohol, with more opalescent. *Ol. aurantii corticis* yield 2.8 per cent. from fresh peel; with 7 to 10 parts alcohol a slightly turbid solution. *Ol. bergamottæ* yield 2 to 3 per cent.; soluble in half alcohol, with more opalescent. *Ol. limonis* yield 1.7 to 2.1 per cent.; with 10 alcohol turbid. (See *Am. Journ. Phar.* 1858, 136, and 1860, 543.)
Camelliaceæ.		
Thea Bohea—Tea	leaves	Small proportion; lemon-yellow, light, congeals readily; exhilarant; combined with theinia said to be diuretic and diaphoretic.
Geraniaceæ.		
Pelargonium radula, Roseum	flowering herb	Yields Turkish oil of geranium; distilled at Cannes and in Algeria; resembles rose in odor; most species of Pelargonium are sweet scented.
Pelargonium odoratissimum (Willd.)	.....	By fractional distillation its oil yields geranid $C_{20}H_{18}O_{21}$; colorless; boils at 232° C.; yields with fused CaCl a crystalline compound, and with hydrate of potassium valerianic acid.
Rutaceæ.		
Diosma crenata—Buchu " crenullata, serratifolia	leaves leaves	16 oz. yield 51 to 68 grains; yellowish-brown, diuretic.
Gallipea cusparia—Angustura	bark	16 oz. yield 7 to 23 grs.
Ruta graveolens—Rue	herb	Is principally $C_{11}H_{22}O$; stim. antispasmod. emmenagogue; yield from dry plant .34 per cent.; sp. gr. .85 to .91; soluble in 1 alcohol, with more flocculent; has been made synthetically.
Leguminosæ.		
Genista Canariensis—Canary rose-wood	wood	80 lbs. yield from 9 to 16 drachms of oil. Oil of rhodium.
Rosaceæ.		
Cydonia vulgaris—Quince	peel	16 oz. yielded by expression 4 grs.
Rose centifolia — Hundred-leaved rose	petals	100 lb. rose leaves yield less than 3 dr.; sp. gr. .83 to .87; below 86° it assumes the consistence of butter; the odor not altered by H_2SO_4; with 100 alcohol turbid; the inodorous stearopten is C_4H_{16}.
Rosa sempervirens — Evergreen rose, and other species	"	
Sanguisorba officinalis — Common burnet	root	Color blue; cordial.
Spiræa ulmaria lobata, filipendula, etc.—Meadow sweet	herb	$C_{10}H_{16}$ and hydruret of salicyle $C_7H_6O_2$; boiling point 380°; sp. grav. 1.173.

Myrtaceæ.		
Caryophyllus aromaticus--Cloves	flower-buds	$C_{10}H_{16}$ and caryophyllic acid $C_{20}H_{15}O_5$; boils at 470° F.; yield 11.1 to 14.28 per cent.; sp. gr. 1.03 to 1.06; soluble in 1 p. alcohol. (See *Am. Jour. Phar.* 1862, 25.)
Eugenia pimenta—Allspice	fruit	Yield as much as 6 per cent.; compos. like oil cloves $C_{10}H_{16}$ and $C_{10}H_{12}O_2$.
Melaleuca cajeputi—Cajeput	leaves	$C_{10}H_{16} + H_2O$, green; sp. gr. .91 to .97; stimul. antispasm.; soluble in 1 part alcohol. (*Am. Jour. Phar.*, 1861, 545.)
Myrtus communis—Common myrtle	leaves & flowers	Very fragrant; 100 lb. fresh leaves yield $2\frac{1}{2}$ to $4\frac{1}{2}$ oz.
Myrcia acris—Sweet bay	leaves	Sp. gr. near .97; little soluble in alcohol; contained in bay rum. (See *Amer. Jour. Phar.* 1861, 296.)
Canellaceæ.		
Canella alba—Canella, White, cinnamon	bark	$C_{10}H_{16}$, odor of cajeput, and oxygenated portions, perhaps caryophyllic acid; yield .57 per cent.
Crassulaceæ.		
Rhodiola rosea—rose root	root	1 lb. yields 1 dr., substitute for oil of rhodium.
Umbelliferæ.		
Anethum graveolens—Dill	fruit	Carminative; soluble in 1440 parts of water, and all proportions of alcohol; sp. gr. .88 to .95; yield 1.5 to 6 per cent.
Angelica Archangelica—Angelica	root	16 oz. yield $\frac{1}{2}$ to 1 drachm, contains C_5H_8O.
Apium graveolens—Celery	fruit	Colorless or yellowish, agreeably aromatic.
Apium petroselinum—Parsley	herb	$C_{10}H_{16}$ and C_6H_8O. Herb yields $\frac{3}{4}$, the fruit 3 per cent.; sp. gr. 1.02 to 1.14; soluble in $2\frac{1}{2}$ to 3 p. alcohol; fulminates with I. Occasionally used as diuretic.
Athamantum aureoselinum—Mountain parsley	herb	$C_{10}H_{16}$ and little O; odor reminding of juniper; sp. gr. .843.
Carum carui—Caraway	fruit	$C_{10}H_{16}$ and carvol $C_{10}H_{14}O$; yield 2.7 to 9 per cent.; sp. gr. .90 to .97; soluble in 1 p. alcohol. Carminative.
Cicuta virosa—Water hemlock	"	Identical with oil of cumin seed.
Coriandrum sativum—Coriander	"	16 oz. yield $\frac{1}{2}$ to 1 dr., sp. gr. .85; $C_{10}H_{16}$ and $C_{10}H_{18}O$.
Cuminum cyminum—Cumin	"	Cymol $C_{10}H_{14}$ and cuminol $C_{10}H_{14}O$; yield 1.2 to 3.9; sp. gr. .90 to .97; soluble in 3 p. alcohol; acrid.
Daucus carota—Carrot	"	16 oz. yield 30 grs.; diuretic, stimulant.
Fœniculum vulgare--Fennel	"	Composition like oil of anise; but $C_{10}H_{12}O$ still liquid at 14°, boils at 440°; yield 2 to 6 per cent.; sp. gr. .89 to 1.—; soluble in 2 to 4 p. alcohol.
Galbanum officinale—Galbanum	resin	Taste and smell like resin, camphorous; sp. gr. .912; used internally and externally in ointments, etc.
Imperatoria ostruthium—Masterwort.	root	$C_{10}H_{16}$ and hydrur. angelyle C_5H_8O; boiling commences at 335°; taste aromatic, burning.
Levisticum officinale—Lovage	"	Yield about .25 per cent.
Osmorhiza longitylis—Sweet cicely	"	Has the odor and taste of anise; probably identical with oil of anise.
Phellandrium aquaticum—Water dropwort	fruit	16 oz. yield from 2 scr. to 2 dr.; golden yellow; taste sweetish, afterwards burning.

Pimpinella anisum—Anise	fruit	Like oil of star anise (*see* Magnoliaceæ); yield 1.4–3 per cent.; sp. gr. .97–1; soluble in 5 alcohol.
" saxifraga	root	Golden yellow, thin; odor like parsley, not agreeable; taste bitter acrid.
" nigra	"	Light blue, changing to green; otherwise like former.
Caprifoliaceæ.		
Sambucus nigra—Common elder	flowers	Yield small; thick, mild stimulant.
Valerianeæ.		
Valeriana officinalis—Valerian	root	Borneen $C_{10}H_{16}$ and valerol $C_6H_{10}O$; the latter oxidizes in the air to a resin and valerianic acid; antispasmodic; yield .35 to 1.8; sp. gr. .87 to .97; soluble in 1 alcohol. (See *Am. Jour. Phar.* 1859, p. 414; 1862, p. 329.)
Compositæ.		
Achillea millefolium—Yarrow	herb and flowers	16 oz. yield 5 to 13 grs.; sp. gr. .9; color blue or deep green; tonic and anti-spasmodic.
Achillea moschata—Iva or forest lady's herb, Switzerland	herb	The oil begins to boil at 170° C The heavier portion has the odor of wormwood; the lighter portion agreeable odor, reminding of peppermint. Comp. $C_{24}H_{40}O_2$, called *Ivaol.*
Anthemis nobilis—English chamomile	flowers	16 oz. yield 22 to 55 grs.; spec. gr. .908; hydrur. angelyle $C_{10}H_{16}O_2$, angelicic acid $C_5H_8O_2$ and $C_{10}H_{16}$. Color blue or green.
Arnica montana—Arnica	flowers root	1 lb. yellow yields about 3 grs.; sp. gr. .90; butyraceous; yields 4 scruples; yellowish; odor reminding of cloves; sp. gr. .987, by HNO_3 grass-green.
Artemisia absinthium—Wormwood	herb and flowers	Comp. $C_{10}H_{16}O$, crude oil brownish-green; yield 4 to 1.1 per cent.; soluble in 1 p. alcohol; sp. gr. .88 to .97.
Artemisia dracunculus—Tarragon	herb	Composition like oil anise, $C_{10}H_{12}O$, liquid; boils at 400°.
Artemisia contra Judaica and santonica (Semen contra, S. cynæ)	flower buds	Spec. grav. .91 to .97; dissolves in an equal part of alcohol, not anthelmintic; bitter; $C_9H_{15}O$.
Dahlia pinnata—Dahlia	tubers	Strong odor; sweetish, burning taste; when kept with water, it becomes heavier than it.
Erechthites hieracifolia — Fireweed	herb	Soluble in 9 p. alcohol; occurs sometimes in American oil of peppermint. (*See* Stearns's paper in *Proc. Am. Ph. Ass.*, 1858; also *Am. Jour. Ph.*, 1860, p. 105.)
Erigeron Canadense — Canadian fleabane	"	Spec. grav. .845; anti-hemorrhagic.
Erigeron Philadelphicum—Philadelphia fleabane	"	Yield very small; "
Inula helenium—Elecampane	root	16 oz. yield from $\frac{1}{4}$ to 1 dr.
Matricaria chamomilla — German chamomile	flowers	Resembles oil of anthemis; color blue; yields 4 to 9 per cent.; $5C_{10}H_{16} + 3H_2O$; sp. gr. .92 to .94; soluble in 8 to 10 p. alcohol.
Matricaria parthenium—Feverfew	flowering herb	8 per cent. from fresh herb; $C_{10}H_{16}$ and $C_{10}H_{16}O$; greenish or straw yellow; light, odor strong camphoraceous.
Osmitopsis astericoides—(Cape of Good Hope)	herb	Greenish-yellow; odor reminding of camphor and cajeput; taste burning, acrid; sp. gr. .931; $C_{10}H_{16}$ and $C_{10}H_{18}O$.

Tanacetum vulgare—Tansy	herb	Yellow or greenish; taste warm, bitter; the oil from the flowers has an acid reaction; yield .5 to .8 per cent.; sp. gr. .91 to .95; soluble in 1 p. alcohol.
Ericaceæ.		
Gaultheria procumbens—Wintergreen	"	Comp. $C_{10}H_{16}$ and methylsalycic acid $C_8H_8O_3$; boiling point 412°.
Ledum palustre—Labrador tea	leaves	1½ per cent.; $C_{10}H_{16}$ and oxygenated oil; pale yellow; odor and taste aromatic, hot.
Jasmineæ.		
Jasminum grandiflorum and fragrans—Jessamine	flowers	Yield very small; extracted by a fixed oil, from which alcohol takes it up; very fragrant; used in perfumery.
Verbenaceæ.		
Aloysia citriodora—Lemon-scented verbena	herb	Small proportion; very fragrant; in commerce usually substituted by lemon-grass oil.
Labiatæ.		
Hedeoma pulegioides—Pennyroyal	"	Carminative, emmenag., spec. grav. .948.
Hyssopus officinalis—Hyssop	"	Odor persist. arom.; taste hot, camphor's; yield 1 to 1¾ per cent.; sp. grav. .89 to .98; soluble in 1 to 4 p. alcohol, with more opalescent.
Lavandula spica—Spike lavender	herb and flowers	Oleum spicæ, similar to and sold for cheap oil of lavender; that usually kept is fictitious, princ. turpentine; the fresh plant yields .8 to 1.75 per cent.; sp. gr. .81 to .98; soluble in 1 p. alcohol; fulminates with iodine.
Lavandula vera—True lavender	herb and flowers	$C_{10}H_{16}O_2$ and $C_{15}H_{28}O_2$; the lightest oil from selected flowers is most fragrant; yield 3 to 4.7 per cent.; sp. gr. .87 to .95; soluble in 1 p. alcohol; fulminates with iodine.
Marrubium vulgare—Horehound	herb	Very small quantity.
Melissa officinalis—Lemon balm	.....	Used for flavoring medicines; also in perfumery; yield .04 to .3 per cent.; sp. gr. .85 to .97; soluble in 5 to 6 p. alcohol.
Mentha aquatica—Watermint	herb	This and other species of mentha are often mixed with peppermint in distilling the oil; yields nearly 1 scr. to the pound.
Mentha crispa—Curled-leaved mint	"	Not so cooling as peppermint; freezing in the cold; yield 1 to 2.3 per cent.; sp. gr. .87 to .97; soluble in 1 p. alcohol.
Mentha piperita—Peppermint	"	$C_{10}H_{20}O$ and menthen $C_{10}H_{18}$; boiling point 365°; best distilled by steam; yield .8 to 1.3 per cent.; sp. gr. .84 to .97; soluble in 1 to 3 p. alcohol; more, opalescent. (*See* Stearns's paper in *Proc. Am. Ph. Ass.*, 1858, and *Am. Journ. Ph.*, 1860, 105.) Oil of peppermint has been used for local anæsthesia. Prof. Flukiger has called attention to the magnificent fluorescence of peppermint oil; 1 drop nitric acid, sp. gr. 1.2, added to 50 to 70 drops of the oil, causes this to appear after an hour or two; heat hastens the appearance, and 2 or 3 times the quantity of acid develops it almost instantly.

Mentha pulegium—Europ. penny-royal	herb	$C_{10}H_{16}$ and $C_{10}H_{16}O$; 100 lbs. fresh herb yield rather less than 1 lb.; sp. gr. .927; boils at 395°.
Mentha viridis—Spearmint	"	Spec. grav. .91; $C_{16}H_{28}O$ (Kane); boiling point 320°; 100 lbs. fresh herb yield 3 oz.; soluble in less than 1 p. alcohol.
Monarda punctata—Horsemint	"	$C_{30}H_{42}O$ and thymol $C_{10}H_{14}O$, solid at 40° F.; rubefacient.
Nepeta cataria—catnep	"	16 oz. fresh herb yield 9 grs.; carminative.
" citriodorata—Lemon catmint	"	16 oz. yield 7½ grs.; odor pleasant; fulminates with iodine.
Ocymum basilicum—Sweet basil	herb and seeds	Yield from herb 1.5 per cent., from seed .12 per cent.; $C_{10}H_{16}$ and $C_{10}H_{22}O_3$; the stearopten red by H_2SO_4.
Origanum creticum—Spanish hop	flowering tops	Yield 1.5 per cent.; straw-yellow, red; brown when old; sp. gr. .946; odor and taste aromatic, hot; the commercial oil is generally adulterated with oil of turpentine; used for bathing and in toothache.
Origanum majorana—Sweet marjoram	herb	Pale yellow; tonic, stimulant; its camphor is $C_{14}H_{30}O_5$; yield .4 to 2.2 per cent.; sp. gr. .89 to .90; soluble in 1 p. alcohol; slightly opalescent with more.
Origanum vulgare—Origanum	"	$C_{50}H_{80}O$, boils at 354°; rubefac.; oil of commerce often adulterated; yield 1.5 to 2.34; sp. gr. .87 to .90; with 12 to 16 p. alcohol a turbid solution; fulminates with I.
Pogostemon—Patchouly	.....	Distils at 282° to 294° C.; contains a carbo-hydrogen $C_{30}H_{26}$ and a stearopten homologous with Borneo camphor $C_{10}H_{18}O$; crystalline form is hexagonal, melting at 54° to 55° C., boiling at 296° C.
Rosmarinus officinalis—Rosemary	herb	$C_{45}H_{76}O_2$? boiling point 365°; mostly adulterated with oil of turpentine or oil of spike; yield .8 to 2.5 per cent.; sp. gr. .88 to .93; soluble in 1 p. alcohol.
Salvia officinalis—Sage	"	$C_{12}H_{20}O$ and $C_9H_{15}O$; tonic and diuretic; yield .4 to 1.34 per cent.; sp. gr. .86 to .92; soluble in 1 p. alcohol.
Satureja hortensis—Summer savory	"	.25 per cent.; yellowish; fragrant; in perfumery.
Thymus serpyllum—Lemon thyme	"	The fresh plant yields oil of acid reaction; reddish-yellow; used in perfumery, and in liniments and ointments; yield .07 to .4; sp. gr. .89 to .95; soluble in 1 p. alcohol.
Thymus vulgaris—Garden thyme	"	Comp. thymen $C_{10}H_{16}$ and thymol $C_{10}H_{14}O$; colorless, turns yellow and brown-red; yield .4 to 2.5 per cent.; sp. gr. .87 to .90; soluble in 1 p. alcohol.
Borraginaceæ.		
Heliotropium peruvianum and grandiflorum—Heliotrope	flowers	Small quantity; extracted by oils; odor vanilla-like; in perfumery.
Convolvulaceæ.		
Convolvulus scoparius and floribundus. Rosewood	subterranean stem	Nearly colorless; thin; odor rose-like; frequently adulterated with fat oil; used for adulterating otto of rose; in perfumery, oil of rhodium.

Oleaceæ.		
Syringa vulgaris—Lilac	flowers	Small proportion; usually extracted by fat oils; used in perfumery.
Chenopodeæ.		
Chenopodium ambrosioides—Mexican tea	herb	16 oz. yield 26 grs.; burning aromatic taste and smell.
Chenopodium anthelminticum — Wormseed	seed	$C_{10}H_{16}$ and $C_{10}H_{16}O_2$; anthelmintic; yield 1 per cent.; sp. gr. .908.
Laurineæ.		
Cinnamomum aromaticum — Chinese cinnamon	bark	Comp. $C_{10}H_{16}$, hydruret cinnamyle = C_9H_8O, cinnamic acid = $C_9H_8O_2$, and resin; Chinese cinnamon yields .2 to 2.0 per cent.; sp. gr. 1.03 to 1.09;
Cinnamomum Zeylanicum—Ceylon cinnamon	"	soluble in 1 p. alcohol; Ceylon cinnamon yields .8 to 2.5 per cent.; sp. gr. 1.006 to 1.09; soluble in 1 p. alcohol.
Cinnamomum Loureirii — Cassia buds	flower buds	Agreeably aromatic, hot.
Cinnamomum Culilavan — Culilawan	bark	Colorless; odor of cajeput and clove; heavier than water; by HNO_3 carmine-red.
Laurus nobilis—Bay tree	berries	16 oz. yield ½ to 1 dr.; sp. grav. .914; comp. $C_{20}H_{32}O$, contains two isomeric oils.
Laurus Burmanni?—Massay bark	bark	Consists of a light and heavy oil; odor of sassafras; turned red by HNO_3.
Ocotea Pichury minor—Pichury	fruit	Yield .7 per cent.; greenish; contains 4 oils, differing in boiling point and odor.
Ocotea?	?	Origin unknown, though called Guiana laurel oil; $C_{10}H_{16}$ and some O; sp. gr. .864; odor terebinthinate, agreeable.
Persea caryophyllata—Clove cinnamon	bark	Thick; dark red-brown; odor and taste of cloves and cinnamon; used in perfumery.
Sassafras officinale—Sassafras	wood and bark	$C_{10}H_{16}$ and $C_{10}H_{10}O_2$; boils at 420°; yield 2.5 to 4.5; sp. gr. 1.07 to 1.09; soluble in 4–5 p. alcohol.
Myristicæ.		
Myristica moschata—Nutmeg	kernel	Ol. nuc. moschat.; yield 6 per cent.; sp. gr. .92 to .95; compos. like next.
" " "	arillus	Oleum macidis is oftener met with in commerce; $C_{16}H_{32}O_5$ and C_8H_{12}; yield 1.6 to 9.4 per cent.; sp. gr. .92 to .95; soluble in 6 p. alcohol.
Santalaceæ.		
Santalum myrtifolium — White saunders	wood	16 oz. yield ½ to 2 dr.; used in perfumery.
Aristolochiaceæ.		
Asarum Canadense—Canada snakeroot	root	Light colored, fragrant.
Asarum Europæum—Asarabacca	"	Yield 12 grs. fr. 16 oz.; spec. grav. 1.018, comp. C_8H_8O; camphor C_4H_5O; yellowish, thick; odor reminding of valerian.
Serpentaria Virginiana — Virginia snakeroot	"	Yield about ½ per cent.; color green.
Euphorbiaceæ.		
Croton eleuteria—Cascarilla	bark	16 oz. yield 27 to 68 grs.; spec. grav. .92; used for fumigation; $C_{14}H_{20}O$ and another oil.

Urticeæ.		
Humulus lupulus—Hop	strobiles	Spec. gr. .91; $C_{10}H_{16}$ and $C_{10}H_{18}O$; taste burning and bitterish; yield .8 per cent.
Myricaceæ.		
Myrica gale—Sweet gale—Dutch myrtle	leaves	100 lb. yield 2 drs.; dark yellow or brown; thickish; agreeable odor; burning taste; sp. gr. .876; with I green.
Coniferæ.		
Thuja occidentalis—Arbor vitæ	young branches	Colorless or yellow, heavier than water; contains C_5H_9O and $C_8H_{14}O$.
MONOCOTYLEDONS.		
Zingiberaceæ.		
Alpinia galanga—Galangle	root	16 oz. yield 1 to 3 scr.; taste sim. cardam.
Curcuma zedoaria—Zedoary	"	16 oz. yield 1 dr.; thick, yellowish-white.
Elettaria cardamomum — Cardamom	seed	Odor penetrating, aromatic; taste hot, camphorous; yields 4 to 4.7 per cent.; sp. gr. .93 to .96; soluble in 1 p. alcohol.
Zingiber officinale—Ginger	rhizoma	16 oz. yield ½ to 2 dr.; compos. $C_{10}H_{16}$ + variable prop. H_2O; sp. gr. .89; odor agreeable, ginger-like; taste mild; afterwards burning and bitter.
Amaryllidaceæ.		
Polyanthes tuberosa—Tuberose	flowers	Small proportion; extracted by fixed oils; used in perfumery.
Irideæ.		
Crocus sativus—Saffron	pistils	16 oz. yield 1½ dr., yellow, heavier than water, acrid; by keeping it turns white and lighter; probably the active princ.
Iris florentina—Orris	rhizoma	Crystallizable; contains 21 per cent. O; odor of violets. (Irin.)
Liliceæ.		
Convallaria majalis—Lilly of the valley	flowers	Quantity very minute; the odor extracted by fat oils; used in perfumery.
Aroideæ.		
Acorus calamus—Calamus	rhizoma	100 lb. fr. rt. yield 16 oz.; 1 lb. dry 25 to 145 grs.; sp. gr. .89 to .99; soluble in 1 p. alcohol; $C_{13}H_{20}O$ and other oils.
Gramineæ.		
Andropogon ivarancusæ—East India lemon grass	herb	$C_{10}H_{16}$ and oxygenated oil; yellow; lighter than water; odor resembling rose; taste reminding of lemon; used to adulterate the German otto of rose, and sometimes sold as oil of verbena.
Andropogon Schœnanthus	"	Resembles the former; but odor of melissa; substituted for oil of melissa, and sold under the name of E. I. oil of melissa and oil of citronella.

CLASS 3D.—NITROGENATED OILS.

The few known contain prussic acid, from which they may be freed by agitating with protochloride of iron and lime and rectifying, without materially altering their odor. They do not pre-exist in the plants from which they are derived, but are the results of a reaction in the presence of water, between amygdalin with emulsin or similar compounds.

The following syllabus embraces the most prominent plants which yield volatile oils containing hydrocyanic acid; it will be observed that they are all members of the natural order of *Rosaceæ*, mostly of the sub-order *Amygdalæ* and a few of *Pomeæ*:—

Amygdalus communis, var. amara —Bitter almond	kernels	These oils are very similar in their sensible properties; the oil of almond is hydruret of benzyle C_7H_6O in which hydrocyanic acid HCy is dissolved. All are poisonous.
Cerasus (various species)—Cherry	bark	
Persica vulgaris—Peach	leaves & kernels	
Prunus domestica and others—Plum		
Pyrus communis and malus—Pear and apple	leaves & kernels	25 lbs. of bitter almond cake after the expression of the fixed oil yield about 2 oz. oil of bitter almond.

Nitrogenated Oils.

	(Yield from 1 lb.)	Sp. gr. 1.04–1.07. Boiling point, 320° to 390° F.; react acid on litmus paper. Iodine is quietly dissolved in small quantity. Nitric acid no reaction in cold; on boiling very little nitrous acid is evolved. Sulphuric acid dissolves an equal quantity of oil, separated by water, little thickened. Alcohol of 85 per cent. miscible in all proportions. Nitroprusside copper, no reaction. Product of boiling with alcoholic caustic potassa in excess dissolves in water.
Oleum amygdal. am.	16 to 80 grs.	
" cerasi sem.	25 grs.	
" lauro-cerasi fol.	40.5 "	

Class 4th.—Sulphuretted Oils.

Of the oils belonging to this group, only oil of mustard has been used medicinally, particularly in alcoholic solution, under the name of spiritus sinapis, as a powerful rubefacient. But the activity of all the plants yielding these oils is due to them, at least principally so.

Some of these plants are valued for culinary purposes, owing to the presence of the compounds of allyle. It is worthy of note that, with the exception of assafœtida, sagapenum, and garlic, all belong to the family of Cruciferæ, many plants of which likewise yield an abundance of fixed oils, obtained by expression, free from the essential oils; they are extensively cultivated for these.

The sulphuretted oils are compounds of *allyle*, and of its homologous carbo-hydrogen *ferulyle*, as the following table will show:—

Allyle	$(C_3H_5)_2$	Sulphide of allyle (oil of garlic)	$(C_3H_5)_2 + S$
Oxide of allyle	$(C_3H_5)_4O$	Sulphocyanide of allyle (oil of mustard)	(C_3H_5CNS)
Ferulyle	C_6H_{12}	Protosulphide of ferulyle } oil of	$C_{12}H_{22}S$
		Bisulphide of ferulyle } assafœtida	$C_{12}H_{22}S_2$

SYLLABUS OF PLANTS YIELDING SULPHURETTED OILS, ETC.

DICOTYLEDONS.		
Cruciferæ.		
Alliaria officinalis — Jack by the hedge	leaves and root	$C_6H_{10}S$, if distilled from fresh spring root it is $C_8H_{10}NS_2$
Capsella bursa pastoris — Shepherd's purse	seed	$C_6H_{10}S$ and $C_8H_{10}NS_2$.
Cheirarthus annuus—Wall-flower	seed	Same compos.
Cochlearia armoracia—Horse-radish	root	$C_8H_{10}NS_2$; 100 lb. fresh root yield nearly 7 oz.
Cochlearia officinalis — Common scurvy grass	herb	Same comp. contained in spiritus cochleariæ.
Iberis amara—Bitter candytuft	herb and seed	Same comp.
Lepidium sativum, campestre, etc. —Cress	seed	$C_6H_{10}S$; is decomposed on rectification.
Raphanus raphanistrum — Wild mustard	seed	$C_6H_{10}S$ and $C_8H_{10}NS_2$.
Raphanus sativus—Radish	root and seed	Same composition.
Sinapis nigra—Black mustard	seed	$C_8H_{10}NS_2$; yield 5 per cent.
Sisymbrium nasturtium — Water-radish	seed	Same and $C_6H_{10}S$.
Thlapsi arvense—Treacle mustard	herb and seed	$C_6H_{10}S$ and $C_8H_{10}S$.
Umbelliferæ.		
Ferula assafœtida—Assafœtida	gum-resin	$C_{12}H_{22}S$ and $C_{12}H_{22}S_2$; yellow; sp. gr. .942; on standing liberates H_2S.
" persica (?)—Sagapenum	"	Contains $C_5H_{10}S$ or $C_{12}H_{24}S$ (?)
MONOCOTYLEDONS.		
Liliaceæ.		
Allium sativum—Garlic	bulb	$C_6H_{10}S$ and $C_6H_{10}O$. 100 lb. yield 3 to 4 oz.; heavier than water

Oils that may be obtained artificially.

1. *Oxygenated.*

Oil of cinnamon from styrone $C_9H_{10}O$ by platina black $= C_9H_8O$ hydruret of cinnamyle. Oil of gaultheria from 2 parts crystal. salicylic acid $C_9H_8O_3$, 2 anhydrous methylic alcohol CH_4O, and 1 $H_2SO_4 = C_8H_8O_3$.

2. *Nitrogenated.*

Oil of bitter almonds, from styracine $C_{18}H_{16}O_2$ by HNO_3, besides benzoic and nitro-benzoic acids also $= C_7H_6O_2$ and HCN.

3. *Sulphuretted.*

Oil of mustard, from iodide of propylene, C_3H_5,I by sulpho-cyanuret of potassium $CNSK = C_3H_5CNS$.

CLASS 5TH.—EMPYREUMATIC VOLATILE OILS.

If organic substances are subjected to dry distillation, the distillate contains, besides water, some acids and also some oily liquids, which, so far as they are used in medicine or accompany medicinal products, are here treated of. Their composition varies very much, as would be expected, and they have but few properties in common except their physical appearance, their empyreumatic odor, and their indifference towards certain chemical reagents. After rectifi-

cation they are usually colorless, and are mostly not affected by iodine and but little attacked by cold nitric acid.

Dippel's animal oil, formerly much used in medicine, has an alkaline reaction, consists of various ternary alkaloids, and turns dark under the influence of light and air. Poisonous; used as antispasmodic. DOSE, 5 to 25 drops.

CAMPHORS.

This class of solid crystalline substances has already been shown to have a close relation to the essential oils. Common camphor, $C_{10}H_{16}O$, is obtained from an evergreen-tree growing in China and Japan, the roots and twigs of which are cut into chips and placed with water in large iron vessels, surmounted by earthen capitals furnished with a lining of rice straw. A moderate heat being applied, and the camphor volatilized by the steam, it collects upon the straw in a crude and impure condition, and is collected and packed for exportation as crude camphor. It is refined by resublimation, and then constitutes the valuable and characteristic drug so familiar to almost every one. As already stated, camphor is an oxide of the radical $C_{10}H_{16}$, and one of the so-called camphene series.

Some of the essential oils can be converted into camphors by solution in water and long exposure. The carbo-hydrogen constituents of these combine with the elements of water to form hydrates, which appear to be the true camphors. These are solid, colorless, crystalline, fusible bodies, less volatile than the essential oils, soluble in alcohol and ether, and partially in water.

Some of the substances usually treated of as neutral crystalline principles are classified by the German chemists as camphors; of this number cantharidin, the active principle of Spanish flies, and nicotianin, one of the constituents of tobacco, may be instanced. There is much obscurity now connected with the precise habitudes and relations of these and other crystalline principles associated with oils and otherwise distributed in plants.

Three different kinds of camphor have been distinguished by their behavior in the polariscope, one turning the ray of polarized light to the left, one to the right, and one being inactive. The camphor deviating to the right is stated to be that from Laurus camphora.

Camphor deviating to the right.—The vapor conducted over red-hot iron gives an oily liquid containing naphthalin and a hydrocarbon of the composition of benzole. Under the influence of heat and nitric acid, 3 eq. of oxygen combine with camphor to form camphoric acid, $C_{10}H_{16}O_4$, which deviates light to the right. Anhydrous phosphoric acid and fused chloride of zinc produce water and cymol, $C_{10}H_{14}$.

Camphor deviating to the left.—From the oil of Matricaria parthenium, that portion distilling between 200° and 220° C. With nitric acid this furnishes camphoric acid which deviates light to the left.

Inactive camphor, from the volatile oils of many of the Labiatiæ, lavender, marjoram, sage, etc. These are without effect upon polarized light.

The camphors from oil of tansy and valerian, and that from sage by nitric acid, have not been tested by the polariscope.

Borneo camphor, obtained from Dryobalanops camphora, and held in the East Indies at a very high price, is a hydrate of borneen, and has the composition $C_{10}H_{18}O_2$. It is said to be deposited by moist oil of valerian. Its alcoholic solution deviates polarized light towards the right. By the action of nitric acid it loses two equivalents of hydrogen, and is converted into common camphor.

Löwig describes numerous camphors, of which the following are illustrations: Lemon camphor, a compound of oil of lemon and water, has the composition $C_{10}H_{22}O_6$; but, by being heated, loses two atoms of water. Juniper-berry water, treated with caustic potassa, yields a camphor $=C_{10}H_{18}O$. The crude oil distilled from parsley seed, dissolved in water, after a few days, deposits a camphor $=C_{10}H_7O_2$.

Caryophyllin, $C_{10}H_{16}O$, the camphor of cloves, occurs in white needles; inodorous and tasteless when pure; soluble in ether and boiling alcohol; colored blood-red by H_2SO_4.

Mint camphor, $C_{10}H_{20}O$, from American oil of peppermint; colorless prisms; odor and taste of peppermint: very soluble in alcohol and ether.

Anise camphor, $C_{10}H_{12}O$, the crystallizable portion of oil of anise; fusing point, 66°.

Monarda camphor, $C_{10}H_{14}O$, from oil of monarda; white tables; fuses at 118; congeals at 100°.

Myristicin, $C_{10}H_{16}O$, from oil of mace; white needles; odor of the oil; red by H_2SO_3.

Sassafras camphor, $C_{10}H_{10}O_2$, from oil of sassafras; hexagonal prisms; odor and taste of the oil; sp. gr. 1.245; red solution with HNO_3.

Irin, the crystallizable oil of Iris Florentina.

Helenin, $C_{21}H_{23}O_3$, from the water distilled over elecampane; white quadrangular crystals; faint odor and taste; lighter than water; with H_2SO_4 wine-red solution.

Asarin, $C_{20}H_{26}O_5$, from the water distilled over Asarum Europæum; white crystals; gaseous Cl and H_2SO_4 color blood-red or brown-red.

Anemonin, $C_{15}H_{12}O_6$, from the water distilled over Ranunculus acris and various species of Anemone; needles, producing heat and numbness upon the tongue; yield anemonic acid when boiled with BaO.

Nicotianin, from the water distilled from tobacco; odor of tobacco smoke; taste aromatic and bitter; soluble in alcohol, ether, and potassa.

Caoutchouc and Caoutchoucoids.

These principles occur in the milky juice of various plants, principally belonging to the natural orders Euphorbiaceæ, Urticaceæ, and Apocynaceæ, and are suspended therein in the form of true emulsions. In their pure state they are colorless, solid, and either at ordinary or at an elevated temperature, very elastic. They are amorphous, inodorous, and tasteless, lighter than water, insoluble in water and alcohol, and soluble in pure ether, chloroform, and some empyreumatic oils. They consist of carbon and hydrogen (the allied viscin contains also O), and are of very indifferent chemical behavior.

Caoutchouc, gum-elastic, or India rubber, is the product of many plants, particularly of Siphonia elastica and various species of Hevea, Urceola, Artocarpus, Ficus, etc. Sp. gr. .925; composition C_8H_{14} (perhaps like the following $C_{10}H_{16}$); fusible at 445°, and remaining sticky for a long time; 2 parts with 1 p. sulphur and 1 p. magnesia yield a mixture of such hardness that it can be polished.

The vulcanization of caoutchouc was discovered by Hancock, and consists in incorporating sulphur with the anhydrous substance, whereby it loses its solubility in the ordinary solvents.

The extensive uses of caoutchouc, and particularly of the vulcanized, in the arts, are too well known to require to be particularized.

Gutta-percha is obtained from Isonandra gutta, Sapotaceæ, and contains about 14 per cent. white, and 4 to 6 per cent. of yellow resin, which are the oxides of the carbo-hydrogen, $C_{10}H_{16}$, constituting the chief portion of it. It is hard and scarcely elastic at ordinary temperature; but becomes very elastic at a slightly elevated heat; its best solvents are chloroform and oil of turpentine.

Pure white gutta-percha may be procured by dissolving in chloroform, filtering and precipitating with alcohol; after washing with alcohol, and drying, it should be boiled in water, and while still hot, rolled into cylinders.

(*See* Liquor Gutta-Perchæ, page 377.)

Viscin, or Bird-lime, is obtained by expressing the fruit of the mistletoe, Viscum album, and diluting with water; it is transparent, very sticky (German, leim = glue) at the common temperature, contains about 15 per cent. (the pure?) of oxygen, and dissolves in ether, volatile oils, and warm lyes. It is used in Germany for killing flies and catching small birds.

Resins.

The resins are very extensively diffused in the vegetable kingdom, and there is, perhaps, no plant which does not contain one or more principles which might be classified with the resins. The definition of a resin is rather vague, but we may, in a general way, describe among this class substances which are solid at ordinary temperatures, more or less transparent, inflammable, readily fusible, do not volatilize unchanged, become negatively electric by rubbing,

are insoluble in water, soluble in alcohol, and sometimes, also, in ether and oil of turpentine. They are mostly inodorous, and are readily incorporated with fatty bodies by fusion. They are not, as a class, disposed to crystalline forms, being mostly amorphous; their ultimate composition is carbon, hydrogen, and oxygen.

The origin of resins must be looked for in the action of the air on essential oils, which lose part of their hydrogen and absorb oxygen; this may occur, as in the case of turpentine and copaiva, in the plants producing them, or after the extraction of the essential oils. To this fact may be traced their mixed character. The volatile oils being usually mixtures of two or more oils, the resins are apt to be constituted of several similar though not identical resins. By treatment with alcohol, ether, oil of turpentine, etc., the different constituents can generally be separated. Many of the resins—those containing most oxygen—play the part of acids, and are, in fact, designated as such; these form, with alkalies and metallic oxides, compounds, some of which are soluble and others insoluble in alcohol, while some resins are quite indifferent to the action of alkalies. Some, so-called, soft resins possess strong odors; these are usually imperfectly oxidized, and contain portions of essential oil.

Resins generally resemble the corresponding essential oils in their stimulating effects, though some of them, which may be termed acrid resins, including the cathartics, appear to bear no therapeutical relation to the essential oils. A few of the gum resins are adapted, by their control over the nervous system, to use as antispasmodics.

Syllabus of Resins.

I. *Resins Proper.*

Name, origin, etc.	Composition and properties.	Uses.
Cistineæ.		
Ladanum, labdanum. From Cistus Creticus and Cypricus. Sp. gr. 1.186; dark brown, soft.	Volatile oil. 86 per cent. resin, $C_{20}H_{30}O$. 7 per cent. wax.	Obsolete.
Zygophylleæ.		
Guaiaci resina *U.S.P.* From Guaiacum officinale. Sp. gr. 1.205 to 1.228.	80 per cent. resin. Guaiacic acid. Gum extractive.	Alterative stimulant.
Terebinthaceæ.		
Mastich. From Pistacia lentiscus. Sp. gr. 1.074; yellowish grains, softens between the teeth.	Acid resin sol. in cold alcohol, $C_{20}H_{31}O_2$. Masticin; resin soluble in hot alcohol, $C_{20}H_{31}O$. Trace of volatile oil.	Adjunct in pills and basis of a varnish.
Leguminosæ.		
Copaiva resin. From Copaiba.	Soft indifferent resin. Copaivic acid $C_{20}H_{30}O_2$; crystallizable from solution in petroleum.	Stimulant, less active than the oil.

Name, origin, etc.	Composition and properties.	Uses.
Anime. From Hymenæa courbaril.	Acid resin soluble in cold alcohol. Indifferent resin $C_{40}H_{66}O$, cryst. from hot alcohol. sol. 2 per cent. volatile oil.	
Copal. From Hymenæa verrucosa and other trees? Sp. gr. 1.045 to 1.139; very hard; fracture conchoidal; nearly inodorous and taste less.	1. Resin, soft, fusible in water-bath, sol. in 72 per cent. alcohol, and oil of turpentine, $C_{40}H_{64}O_5$. 2. Resin, soft, fusible below 212° F., sol. in alcohol, ether, and oil of turpentine, isomeric with No. 1. 3. Resin, white, not so readily fusible, soluble in alcohol and ether, $C_{40}H_{62}O_3$. 4. Resin, white, still less fusible, sol. in alcohol, solution of potassa, insol. in alcohol and ether. 5. Resin, insol. in all menstrua, $C_{40}H_{62}O$.	Used in varnishes.
Resin of Peruvian balsam. From Balsamum Peruvianum.	Acid, $C_{20}H_{28}O_3$, crystallizes in rhombic prisms.	
Convolvulaceæ.		
Resina jalapæ. From ipomœa jalapa.	Convolvulin, rhodeoretin, $C_{31}H_{50}O_{16}$.	*See* part V. Neutral princip.
Cannabinaceæ.		
Extractum cannabis. From Cannabis Indica.	Neutral resin soluble in alkalies, associated with chlorophylle. By the oxidizing influence of HNO_3, sp. gr. 1.32, yields a crystallizable acid and oxycannabin $C_{20}H_{12}O_8$, in large flat, colorless prisms, insoluble in water and ether, soluble in bisulphide of carbon; melts at 175° C.; sublimes in needles. The most reliable tests for ext. cannabis are its odor when moderately heated; its indifference to alkalies; its insolubility in alcohol, ether, chloroform, benzole, and turpentine; and its reaction with nitric acid.*	Narcotic. *See* Extracta.
Euphorbiaceæ.		
Lac (shellac and seedlac). From Croton lacciferum by the puncture of Coccus lacca, and from Ficus religiosa and Indica—(*Urticeæ*).	Different resins, wax, gluten, coloring matter.	In varnishes, cements, etc.
Euphorbium. From various species of Euphorbia; inodorous; taste acrid, burning.	One resin ($C_{20}H_{31}O_3$) dissolving easily, and another with difficulty in cold alcohol—a third insoluble in cold alcohol, but crystallizes from hot alcoholic solution ($C_{45}H_{70}O_4$).	Acrid, cathartic, vesicant, etc. Obsolete.
Coniferæ.		
Cowrie, Australian Dammar. From Dammara Australis; sp. gr. 1.04 to 1.062.	Dammarane $= C_{20}H_{31}O_3$; soluble only in absolute alcohol and oil of turpentine. 57 per cent. dammaric acid, $C_{20}H_{30}O_3$, soluble in alcohol.	
East Indian Dammar. From Pinus dammara; sp. gr. 1.056 to 1.097; soft at 167°.	Resin soluble in cold alcohol. Dammarine insoluble in cold alcohol.	In varnishes.

* See paper by Prof. Procter, in the Proc. Amer. Phar. Ass., xii. 245.

Name, origin, etc.	Composition and properties.	Uses.
Sandarac. From Juniperus communis in warmer climates, and from Thuja articulata; sp. gr. 1.05 to 1.09; small grains, pale yellow, transparent; faint odor.	75 per cent. $C_{20}H_{31}O_3$, easily soluble in alcohol. $C_{40}H_{62}O_5$, not easily soluble in alcohol. $C_{20}H_{30}O_3$, soluble in boiling alcohol.	In varnishes.
Resina. From Terebinthina.	Colopholic acid, taken up by cold 70 per cent. alcohol. Pinic, amorphous sylvic acid, taken up by cold alcohol of 70 per cent. Sylvic acid, $C_{20}H_{30}O_2$, crystallizes from hot alcohol.	In plasters, soaps, cements, etc.
Fossil Resins.		
Succinum. Amber; sp. gr 1.065 to 1.070; colorless to deep yellow; tasteless; aromatic odor when heated.	Two resins, volatile oil, succinic acid, and bitumen, by action of HNO_3 artificial musk.	For ol. succini, varnishes, etc.
Asphaltum.	Most probably the product of oxidation of oleum petræ. Many bituminous resins are mixtures of asphaltum and petroleum.	In varnishes, roofing, etc.

II. *Natural Oleoresins.*

Name, origin, etc.	Composition and properties.	Uses.
Terebinthaceæ.		
Elemi. From Amyris elemifera and Zeylanica; sp. gr. 1.055; yellowish white; fused at 245°.	60 per cent. acid resin sol. in alcohol, 20 per cent. indifferent resin crystallizing from sol. in hot alcohol. 10 to 13 per cent. volatile oil.	Stim. in ointments.
Cyprian turpentine. From Pistacia terebinthus. The turpentine of the ancients. Opaque, very thick, greenish-yellow; odor of fennel.	Volatile oil. Resin soluble in cold alcohol. Soft resin insoluble in cold alcohol.	Stimulating.
Leguminosæ.		
Copaiba. Sp. gr. .916 to .997. From various species of Copaifera.	31 to 80 per cent. volatile oil. 1.6 per cent. soft brown resin. Copaivic acid, *see* Resins Proper.	Diuretic, stimulant.
Coniferæ.		
Terebinthina. From Pinus palustris, and other species of Pinus; gray, bitter, not transparent.	About 17 per cent. volatile oil. Resina *U. S. P.*	Stim. emmenagogue.
Terebinthina Gallica. French or Bordeaux turpentine. Thin, yellowish, pellucid.	Like the foregoing. The resin contains pimaric acid $C_{20}H_{30}O_2$, which, when heated in alcohol, becomes sylvic acid.	do.
Terebinthina Veneta. From Larix Europæa. Venice turpentine: nearly colorless, transparent.	About 20 per cent. volatile oil. Resins and succinic acid.	In stimulating external remedies.
Terebinthina Canadensis. From Abies balsamea. Balsam of fir.	40 per cent. resin sol. in alcohol. 33.4 sub resin sol. in alcohol with difficulty. 18.6 per cent. volatile oil.	Cement in microscopy.

Name, origin, etc.	Composition and properties.	Uses.
Strasburg turpentine, Terebinthina Argentoratensis. From Abies pectinata; pale yellow, transparent, agreeable odor.	35 per cent. volatile oil. Abietinic acid, abietin, indifferent resin, succinic acid.	Stimulant.
Common olibanum. From Pinus Abies.	Volatile oil. Resin fusible at 212°. " " at 293°.	Stimulating; for fumigations.

III. *Gum Resins.*

Name, origin, etc.	Composition and properties.	Uses.
Guttiferæ.		
Gambogia. From Stalagmitis cambogioides and several species of Garcinia. Brown or reddish-yellow.	19.5 per cent. gum. 80 per cent. gambogic acid.	Powerful cathartic. Yellow, water-color.
Terebinthaceæ.		
Myrrha. From Balsamodendron myrrha; red-brown; semi-transparent.	40.81 per cent. Arabin. 44.76 per cent. resin. 2.18 per cent. volatile oil.	Astringent and emmenagogue.
Bdellium. From Balsamodendron Africanum; reddish-gray; semi-transparent.	59 resin, $C_{40}H_{62}O_5$, 9.2 gum, 30.6 bassorin and volatile oil.	Obsolete.
Olibanum. From Boswellia serrata and an Amyris (?); yellowish; semi-transparent.	4 per cent. (Stenhouse) volatile oil, gum, at least 2 resins, one of which = $C_{20}H_{37}O_3$.	For fumigation.
Umbelliferæ.		
Galbanum. From Bubon galbanum, Ferula ferulago and Galbanum; in grains or cakes; nearly opaque.	66.86 per cent. resin, $C_{40}H_{54}O_7$. 19.28 to 27.3 per cent. gum. 1.3 per cent. mucilage. 6.34 per cent. volatile oil.	Stim., antispasmodic.
Assafœtida. From Ferula assafœtida.	26 per cent. gum, 4.6 per cent. sulphuretted volatile oil, 47.2 to 66 per cent. resin, 11.6 per cent. bassorin, malates, acetates, sulphates, and phosphates.	Antispasmodic.
Sagapenum. From Ferula Persica.	50 per cent. resin, 32 per cent. gum, 3.7 per cent. sulphuretted volatile oil, 3.48 mucilage.	Stim. like assafœt.
Ammoniacum. From Dorema ammoniacum; sp. gr. 1.207; yellow; white internally.	22 per cent. gum. 72 per cent. resin, $C_{40}H_{50}O_9$.	Stim. expectorant.
Opopanax. From Pastinaca opopanax; reddish; internally yellow and red marbled.	42 per cent. resin. 33 per cent. gum. 4 per cent. starch, 4 extractive, 6 per cent. sulphuretted vol. oil.	Antispasmodic. Obsolete.
Asclepiadeæ.		
Scammonium, Smyrna. From Periploca secamone?	An adulterated resin of Convolvulus scammonia?	Cathartic?
Convolvulaceæ.		
Scammonium, Aleppo. From Convolvulus scammonia.	Convolvulin, resin, wax, extractive gum, sugar, starch. Commercial article from 5 to 80 per cent. resin.	Cathartic.

IV. *Balsams.* (*Containing* $\overline{Bz}$ or $\overline{Cin}$.)

Name, origin, etc.	Composition and properties.	Uses.
Styracecæ.		
Benzoinum. From Styrax benzoin; sp. gr. 1.063.	Benzoic acid, $HC_7H_5O_2$, average 15 per cent.; sometimes mixed with more or less cinnamic acid. *a.* Resin, $C_{30}H_{40}O_5$, soluble in ether, not in K_2CO_3. *b.* Resin, $C_{35}H_{42}O_7$, soluble in K_2CO_3, not in ether. *c.* Resin, $C_{40}H_{44}O_9$, soluble in alcohol, not in ether.	As an expectorant and stimulant externally.
Styrax Calamita. From Styrax officinalis; grains or masses; blackish-gray.	Benzoic acid, volatile oil, resins.	For fumigations; rarely used here.
Leguminosæ.		
Balsamum Peruvianum. Sp. gr. 1.14 to 1.16; from Myrospermum Peruiferum.	Cinnamic acid, $C_9H_8O_2$, 6.94 per cent. Oil or cinnameine, 69 per cent. Styracine (metacinnameine) crystallizes in prisms. 23.1 per cent. resin, $C_{20}H_{28}O_3$.	Stimulating expectorant.
White Peruvian Balsam. From the fruit and seeds of the former by expression.	Not fully analyzed, myroxocarpin, $C_{24}H_{35}O_3$; crystallizable, very indifferent resin.	Similar to former.
Balsamum tolutanum. From Myrospermum toluiferum.	Resin, 88 per cent. Cinnamic acid, 12 per cent. Volatile oil, 0.2 per cent.	Stimulating expectorant.
Balsamineæ.		
Styrax. Semifluid juice of Liquidambar orientale.*	Cinnamic acid; styrol (cinnamen) C_8H_8. Styracine $C_9H_9O, C_{18}H_{14}O_2$. Cinnameine, $C_9H_7O_2(C_9H_9$. 2 resins.	do.
Gum wax. Semifluid juice of Liquidambar styraciflua.	Cinnamic acid. (?) Styracine. (?) Resin. (?)	Little used as yet. (*See* Syrups.)

REMARKS ON THE RESINS, OLEORESINS, AND BALSAMS.

As shown in the syllabus, most of the resins proper are used exclusively in varnishes, and in the various modifications of stimulating and rubefacient applications.

Amber is employed in medicine exclusively for the products of its decomposition. Oil of amber produced from it by distillation is a powerful rubefacient, with antispasmodic effects.

Guaiacum may be classed as a resin, though, owing to the presence of a peculiar acid somewhat resembling benzoic and cinnamic, it may be entitled to a place among balsams, should that group be extended to embrace a wider range of resinous substances. Recent investigations of Kosmann show it to be a glucoside, splitting with acids into glucose and guaiaretin.

Burgundy pitch and the so-called *hemlock gum* (Pix Canadensis) are well-known ingredients of strengthening and rubefacient plasters,

* According to Hanbury, London Pharm. Journ., 1857.

which will be considered under the appropriate head. *Elemi* is a popular substitute for common resin in an unofficinal ointment much prescribed by surgeons.

Of the *oleoresins*, the various turpentines differ in their proportion of resin to oil and their consequent consistence. White turpentine of commerce, though exuding from the tree in a liquid form, is always found nearly or quite solid, while balsam of fir and Venice turpentine continue more or less fluid at ordinary temperature. The former of these is much used for mounting objects for the microscope, and for cementing ambrotypes upon glass, its perfect transparency and great adhesiveness adapting it to these uses. The latter is perhaps rarely met with in our commerce, being superseded by a factitious article, said to be composed of about 24 lbs. of resin to the gallon of oil of turpentine. The genuine is esteemed as a useful ingredient in the finest qualities of sealing-wax.

Copaiva, which is very commonly called balsam copaiva, is highly esteemed for its stimulating effects on the mucous surfaces; it is variously combined with mucilage or with alkali in prescriptions mentioned under the appropriate head, and is prescribed in the *Pharmacopœia* in the form of pill mass to be made with magnesia. (*See* Pilulæ.)

Most of the *gum resins* are possessed of decided medicinal effects; ammoniac, benzoin, and tolu are chiefly used as stimulating expectorants. Assafœtida, galbanum, and sagapenum (the latter almost obsolete), are distinguished by powerful effects on the nervous system. Myrrh is peculiarly adapted to the relaxed conditions of the system, consequent on pulmonary and uterine affections; it is well suited to combinations with iron, and is directed in several emmenagogue pills, and in the officinal Mistura ferri composita.

Among the gum resins we have two drastic cathartics, gamboge and scammony; and among the resins proper, podophyllin, resin of jalap, and euphorbium. Olibanum is almost exclusively used for fumigation, being employed alone and combined with cascarilla, and benzoin, as incense, in the ceremonies of the Roman Catholic church.

The balsams vary in their consistence. Benzoin is solid, hard, and brittle; Peruvian balsam (formerly called Myroxylon) is fluid; Tolu is intermediate, being a very soft and readily fusible solid. The best storax is liquid. The true solid storax is little used, though directed in some of the old recipes. A fictitious article is met with in commerce, which is sold for Styrax calamita, and is prepared at Trieste, by coarsely grinding the bark of the storax tree and mixing it with liquid storax. Our native "gum wax," as it has been called, has a very strong resemblance to storax, its consistence being semifluid, and its color and odor almost identical.

Several products of scientific interest have been discovered by the analysis of balsams. *Styracin*, the resin of styrax, is obtained by treating the balsam with caustic soda in solution, dissolving the residue in alcohol and ether, and crystallizing; when acted on with

nitric acid this yields the same products of decomposition as cinnamic acid. By distillation of the soda solution left in its preparation, *styrole* is obtained, while cinnamic acid is left in the residue. Styrol has the composition C_8H_8, and styracin is a compound of cinnamic acid with oxide of cinnamyle, which bears the same relation to hydrated cinnamic acid as common ether does to acetic acid; its aldehyde, C_9H_7OH, is the oil of Chinese and Ceylon cinnamon. An analogous compound is cinnameine, or cinnamate of oxide of tolyle, the alcohol of which is tolylic or benzalcohol, C_7H_7OH, which by oxidation is first converted into its aldehyde oil of bitter almonds, C_7H_6O, and subsequently into benzoic acid, $HC_7H_5O_2$. Styracine and cinnameine are therefore compound ethers, the former cinnamo-cinnamic, the latter cinnamo-tolylic ether. (See *Gregory's Chemistry.*)

Tests of Purity.

Guaiacum.—Entirely soluble in 85 per cent. alcohol and less so in ether; gives a blue color to mucilage of gum Arabic, and milk, and turns green or blue with oxidizing agents.

Mastich.—Softens by chewing, not entirely soluble in alcohol, wholly taken up by ether, chloroform, and oil of turpentine, not by fixed oils.

Copal.—Readily fusible, soluble in rectified oil of turpentine. See syllabus for behavior to alcohol and ether.

Jalap Resin and Scammonium.—By the action of alkalies under the influence of heat, they are converted into convolvulic and rhodeoretinic acid, which is soluble in water. The solution of the resins in alkalies may be rendered slightly opalescent by sulphuric acid, but is not precipitated.

Copaiva.—If adulterated with fixed oil, this may be detected by the stain produced on paper; pure copaiba, after the evaporation of the volatile oil by the application of a little heat, leaves a *resinous* stain, which has a *greasy* margin if the copaiva was adulterated with fixed oil.

Or the balsam is boiled for several hours in an open vessel with water to drive off the volatile oil; pure copaiba leaves a brittle resin, while a soft or semifluid resin remains if the copaiba had been adulterated with fixed oil.

Fixed oils, except castor oil, may be detected by their insolubility in 90 per cent. alcohol; pure balsam furnishes a clear solution.

An adulteration with turpentine (oleoresin) is easily detected by the odor produced by the evaporation of the oils, on dropping the suspected balsam upon a hot brick.

Balsamum Peruvianum.—The surest way to find an adulteration with castor oil is, to distil about 20 grammes until about 10 grammes have passed over and the residue begins to become charred. The distillate, which separates into an aqueous and oily stratum, is agitated with caustic baryta, the oil removed, and agitated with a concentrated solution of bisulphite of sodium. Gen-

uine balsam Peru on dry distillation furnishes products, which with bisulphite of sodium do not form a crystalline combination. The crystals obtained by this process from its admixture with castor oil, on being recrystallized from alcohol, have the odor of œnanthol, and the composition $C_{14}HO,SO_2 + NaO,SO_2$. Larger quantities of castor oil decrease the specific gravity of the balsam; other oils are detected by their insolubility in alcohol. Peruvian balsam is much sophisticated. The genuine article produces an impression of a liquid diffused in the mouth, while the sophisticated is generally a solution of resin which deposits the resin on the tongue when tasted.

CHAPTER VII

ON ORGANIC ACIDS.

Organic Acids are distinguished as a class by characteristic properties. They combine with inorganic and organic alkalies, some of them in several different proportions, according to the number of equivalents of basic water combined with them. Thus, citric is a tribasic acid, containing three equivalents of basic water; tartaric bibasic, containing only two; and benzoic monobasic, containing but one equivalent besides the water of crystallization. These acids are found in nature both free and in combination. Some are very commonly diffused throughout the vegetable kingdom, as tannic; others exist exclusively in one family of plants, as meconic acid in the Papaveraceæ. Some, although existing naturally, are capable of artificial production from other organic material, as oxalic and valerianic. This whole class, and that of organic alkalies, have a much closer relation to inorganic compounds than the neutral crystalline and uncrystallizable principles. They all contain oxygen, and are destitute of nitrogen in their composition; an exception, however, is hydrocyanic acid, which in all its chemical relations bears a close resemblance to the inorganic hydro-acids.

The organic acids are capable of numerous changes during the processes of life in the organisms by which they are produced, or after their introduction into the circulation of other living animals or vegetables. These changes are the result of obscure processes of nature, and of conditions and functions of the organs, which we are unable to imitate by art. Chemistry, however, has in some instances arrived, by artificial means, at close imitations of nature, and has produced changes which furnish connecting links between compounds having apparently no relation to each other.

Of the organic acids, those occurring in plants are by far the most important as medicines, and of the very few animal acids employed, most, though formerly regarded as exclusively belonging

to the animal kingdom, have subsequently been discovered to be direct products of decomposition of vegetable principles, and are even generated by certain plants in their normal processes of growth and assimilation.

In the present chapter the numerous acids are thrown together in groups, either from their diffusion in certain classes of vegetables, from the harmony of some of their physical or chemical relations, from their associations with other organic principles, or from the value attached to them as medicinal agents.

The organic acids, in this work, are classified as follows:—

1st Group—Fruit acids.
2d " Derivatives of the fruit acids.
3d " Acids representing the Medicinal Virtues of plants.
4th " Acids combined with Vegetable Alkalies.
5th " Acids derived from Essential Oils.
6th " Astringent and allied acids.
7th " Acids of animal origin.
8th " Acids pertaining to coloring matters.

First Group.—Fruit Acids.

These acids occur in the fruits of many plants of the families Aurantiaceæ, Rosaceæ, Grossularieæ, in grapes, tamarinds—in short, in all succulent acidulous fruits, and at certain periods of their maturity, in a free state, with the exception of oxalic acid, which is comparatively seldom met with in an uncombined state, though widely diffused, wholly or partly neutralized by certain vegetable alkalies, or inorganic bases. They are all agreeable refrigerants, and, as such, have a very extensive use; combined with alkalies or magnesia, they act in large doses as laxatives; oxalic acid and its compounds are poisonous, unless in minute doses.

Acetic acid, $HC_2H_3O_2$. Occasionally in plants, product of fermentation.
Oxalic " $H_2C_2O_4,2H_2O+4Aq.$ In rhubarb, sorrel, many officinal roots, herbs, and barks.
Tartaric acid, $H_2C_4H_4O_6$. In grapes, tamarinds, etc., obtained from wine deposits.
Uvic " $2HO,C_8H_4O_{10}+2Aq.$ In the deposit of some grape juices.
Malic " $H_3C_4H_3O_5$. In apples, sumach berries, the berries of mountain-ash, etc.
Citric " $H_3C_6H_5O_7,H_2O+2Aq.$ In lemons, oranges, currants, gooseberries, tomatoes, etc.

Acetic acid has been already referred to as produced in the destructive distillation of wood, and also as a product of the spontaneous change which takes place in articles of the saccharine and amylaceous group by the catalytic action of ferments.

Oxalic acid is an instance of an important vegetable acid existing ready formed in plants, and also capable of artificial production. Most of the oxalic acid of commerce is obtained by the action of nitric acid on sugar or starch, the organic principle being oxidized at the expense of the acid. Nitrous acid fumes and carbonic acid gas are evolved, and oxalic acid is formed, which is collected and crystallized, and most extensively used as a bleaching agent. If nitric acid has been employed in sufficient quantity, no saccharic acid is formed; the nitrous acid evolved is employed in the manu-

facture of sulphuric acid or for other purposes where oxidation is required. It is not officinal.

The alkaline oxalates are soluble, but the other salts are mostly insoluble in water. Oxalic acid and its salts are decomposed by a red heat, into carbonic acid and carbonic oxide, without leaving any charcoal. If heated with sulphuric acid the same decomposition takes place. Carbonic oxide CO is inflammable. If mixed with sand and heated, dry oxalic acid yields formic acid, and but little carbonic acid is given off if the temperature is well regulated. The precipitates formed by it with baryta and lime are soluble in nitric and muriatic acids. The silver precipitate dissolves in nitric acid and ammonia. Insoluble oxalates, boiled in concentrated solution of carbonate of sodium, are decomposed, oxalate of sodium being held in solution.

Acidum Tartaricum. $\overline{T}=H_2C_4H_4O_6$.

Tartaric acid is prepared from bitartrate of potassium or cream of tartar, by the addition of carbonate of calcium, whereby insoluble tartrate of calcium is formed with the excess of acid of the bitartrate, and neutral tartrate of potassium left in solution. The solution is decomposed with chloride of calcium, which forms an additional quantity of tartrate of calcium. Lastly, the insoluble tartrate of calcium is purified by washing, and decomposed by sulphuric acid, which liberates the tartaric acid. This, on evaporation, crystallizes in colorless crystals, with a tendency to the form of oblique rhombic prisms (citric acid occurs in right rhombic prisms). It has a sour taste, resembling, though not identical with, that of citric acid. It is soluble in an equal weight of water, from which solution alcohol throws down no precipitate. This is rather a stronger acid than citric, and 100 grains saturate 133.5 grains of bicarbonate of potassium. It is most usually sold in powder. Its principal use is in preparing effervescing and refrigerant drinks, and as a substitute for citric acid.

Liebig has obtained tartaric acid artificially by the oxidation of sugar of milk and gum by nitric acid; besides mucic, oxalic, and saccharic ($H_2C_6H_8O_8$) acids are formed, the latter of which appears to be converted into tartaric acid; both these acids have identical reactions with potassa and lime salts.

The salts used medicinally are the tartrates of potassium, sodium, ammonium, and iron, the bitartrates of potassium, sodium, and ammonium, and the double salts of potassium and sodium, potassium and ammonium, potassium and boracic acid, potassium and borate of sodium, potassium and iron, and ammonium and iron; treated of under the several heads of their bases.

Tartaric acid may be recognized by the copious white crystalline precipitate it furnishes on adding it in excess to any neutral salt of potassium. The precipitate formed by both this and citric acid with acetate of lead should be soluble in nitric acid.

Neutral tartrates are precipitated on the addition of acetate of

potassium and free acetic acid; the precipitate by chloride of calcium is soluble in cold caustic potassa, separates on boiling, and redissolves on cooling; the precipitate by lime-water dissolves in free tartaric acid, and in chloride of ammonium and tartrate of calcium crystallizes out after some time.

If not carefully prepared, the following impurities may be present: heavy metals, detected by sulphuretted hydrogen, sulphuric acid by chloride of barium, muriatic acid by nitrate of silver, oxalic acid by a solution of sulphate of calcium.

Solutions of tartaric acid and its salts are decomposed by oxygen like citric acid; by oxide of manganese it is converted into formic and carbonic acids.

The following well-marked varieties of tartaric acid have been distinguished:—

1. *Dextrotartaric acid*, the ordinary tartaric acid, which in the free state and combined with certain inactive bases turns polarized light to the right. If its salt with cinchonia is heated to 338° F., in five or six hours it has been changed for the greatest part into—

2. *Paratartaric, uvic, or racemic acid*, which also occurs naturally in cream of tartar from certain localities. It and its salts have a neutral behavior towards polarized light. Its double salt with ammonium and sodium is obtained in crystals, one-half of which show a hemiedric form to the right, the other half the same form to the left; the former contain dextrotartaric, the latter the lævotartaric acid. From a solution of paratartrate of cinchonicia crystals of the lævotartrate, and from a solution of paratartrate of quinicia, the dextrotartrate is deposited first, leaving the greatest part of the salts with the opposite acid in solution.

3. *Lævotartaric acid* may be obtained as just stated; it deflects polarized light to the left.

4. *Inactive tartaric acid* is obtained by heating paratartrate of cinchonicia to 338° F. It has no action on polarized light, and cannot be resolved into the right and left tartrate.

5. *Metatartaric acid.* By melting dry powdered dextrotartaric acid in an oil-bath; the change takes place in a few seconds at 340° to 356° F. The acid is hygroscopic; its calcium salt is soluble.

6. *Isotartaric or tartralic acid.* If the heat in the last process has been applied too long, the product contains this acid also. The calcium salt is syrupy, uncrystallizable, and by boiling is resolved into metatartaric acid and metatartrate of calcium.

All of these acids are of the same composition, $H_2C_4H_4O_6$, and, excepting the last, are bibasic.

Pyrotartaric Acid, $H_2C_5H_6O_4$.—Tartaric acid yields by dry distillation at between 350° F. and 370° F. water, carbonic and pyrotartaric acids, scarcely any secondary products. This acid is very soluble, fusible, and not precipitated by neutral lead salts.

Malic Acid, $\overline{Mal} = H_3C_4H_3O_5$, is prepared from the juice of the fruit of Sorbus aucuparia, or of Rhus glabrum and typhinum, by precipitating with sugar of lead, recrystallizing, and decomposing by hydrosulphuric acid. The juice of the rhubarb plant, after

being clarified by isinglass, and evaporated to the consistence of syrup, yields about 3½ per cent. of crystallized bimalate of potassium. The acid crystallizes in four- and six-sided needles and prisms, is deliquescent, and dissolves in water and alcohol.

Though malic acid is present in many pharmaceutical preparations, none of its salts have been used in medicine with the exception of an impure malate of iron, which, in Europe, is still largely employed as a mild chalybeate, under the name of Extractum ferri pomatum; malate of manganese has likewise been somewhat used.

The acid and its salts are not precipitated by lime-water; chloride of calcium occasions a precipitate soluble in acids; the precipitate by acetate of lead melts in boiling water, assuming the appearance of resin fused in water.

Malic acid has acquired some importance as a material for the preparation of succinic acid.

Menispermic or coccalinic, *solanic*, and probably also *nicotic*, *igasuric* (in nux vomica and Ignatia beans), *fungic* (in boletus, helvella, etc.), and others are identical with malic acid.

The results of the decomposition of malic acid by various influences are as follows:—

1. If heated with an excess of potassa to 300° F., it is converted into oxalic and acetic acids. 2. By quick dry distillation it is converted into equisetic or pyromalic acid. 3. If heated in an oil-bath to 300° F., until vapors cease to be emitted, it has been converted into *fumaric* or *paramalic acid*. 4. Neutral malate of calcium $C_4H_4Ca_2O_6$, if kept under water, particularly by the action, as ferment, of beer yeast or old cheese, is converted into succinic, acetic, and carbonic acids. 5. If by this fermentation hydrogen is evolved with the carbonic acid gas, another change takes place, butyric acid being formed. 6. By long contact, no butyric, acetic, or succinic acid is obtained, but another product of decomposition; lactic and carbonic acids.

Acidum Citricum. $\overline{Ci} = H_3C_6H_5O_7,H_2O$.

This is produced from lime or lemon-juice by neutralizing the acid with chalk, and from the citrate of calcium thus formed liberating the citric acid by means of sulphuric acid.

It is in large transparent crystals without color, with a strong, but agreeable acid taste, very soluble in water and in weak alcohol, deliquescing in moist weather. Specific gravity 1.6. As usually obtained in crystals, it consists of one equivalent of the tribasic acid + one (sometimes two) equivalent of water of crystallization. It is not sold in the form of powder. According to the *U. S. Pharmacopœia*, 100 grains of crystallized citric acid will saturate 150 grains of bicarbonate of potassium, which is on the supposition of one equivalent of water of crystallization being present. Its principal consumption is in the preparation of so-called lemon syrup, and solution of citrate of magnesium. To make artificial lemon-juice, add citric acid ℥ixss to water Oj; fresh oil of lemon ♏j; and sugar ℥j.

This solution is much employed in making effervescing draughts. (*See* Potassii Citras.)

There are not many salts of citric acid used in medicine, but most of them very extensively; they are the citrates of potassium, magnesium, iron, quinia, caffeina, and morphia, and the double salts of ammonium and iron, of potassium and iron, and strychnia and iron.

Citric acid and its salts are precipitated on being boiled with an excess of lime-water; the greater part of the precipitate redissolves on cooling; neutral citrates are precipitated by chloride of calcium.

Citric acid is scarcely ever adulterated or impure; if tartaric acid should be present, it may be detected by a concentrated solution of citrate of potassium, which yields a white crystalline precipitate of bitartrate of potassium if tartaric acid is present; if potassa is employed instead of the citrate, care must be taken to leave the liquid strongly acid; oxalic acid by a solution of sulphate of calcium, and sulphuric by a diluted solution of chloride of barium; in both the last cases the appearance of a precipitate is promoted by nearly neutralizing the acid with an alkali.

The solution of citric acid and of its salts is decomposed by the influence of oxygen, with the formation of mould, and a slimy precipitate of apparently organic structure. On fusing the acid with hydrate of potassa, it is converted into oxalic and acetic acids.

Second Group.—Derivatives of the Fruit Acids.

The acids placed in this group may be artificially obtained from the fruit acids; they are also found in a number of vegetables and vegetable products, and two of them are productions of animal organisms. Of their number, three have been more or less used in medicine, the others, as yet, are not employed either in medicine or in the arts.

Formic acid ($HCHO_2$).	In ants, nettles, ergot, the leaves of some pines, old turpentine, etc. Volatile liquid; odor penetrating, stinging; produces severe inflammation. Its salts all soluble in water, decomposed by H_2SO_4 into 2CO and HO; reduces the oxides of Ag, Hg, Au, etc.
Succinic " $H_2C_4H_4O_4$.	In amber, wormwood, Melampyrum nemorosum, Lactuca sativa. Colorless, inodorous, crystals, soluble in 5 p. boiling water and $1\frac{1}{2}$ p. boiling absolute alcohol: scarcely soluble in ether; not decomposed by cold HNO_3, Cl, or Cr_4O_3; the insoluble salts dissolve in acetate of potassium.
Aconitic " $H_3C_6H_3O_6$.	In various species of Aconitum, Delphinium, yarrow, Equisetum, limonum, etc. Colorless granules; readily soluble in water, alcohol, and ether; the crystallized Ca salt little soluble; the lead and silver salts are white flocculent precipitates; colors salts of Fe_2O_2 red; identical with equisetic acid.
Fumaric " $C_4H_4O_4$.	In fumaria (fumatory), Corydalis bulbosa, Glaucium luteum, and Iceland moss. Colorless scales; soluble in 200 p. water, more in alcohol and ether; crystallizing from hot HNO_3; not precipitated by alkaline earths; precipitates Ag salts completely; the lead salt soluble in boiling water without fusion.

Lactic acid, $H_2C_3H_4O_3$.	From milk, many fermented vegetable juices, etc. Colorless uncrystallizable syrup, ; sp. gr. 1.215; little soluble in ether, in all proportions of alcohol and water; the salts are insoluble in ether, sparingly soluble in cold water and alcohol.

Formic Acid.—Chloroform and iodoform are compounds of the same radical, formyle, CH, of which formic acid is the hydrated oxide; it may be prepared artificially by heating equal weights of oxalic acid and glycerin together in a retort for fifteen hours to a temperature of 212° to 220°. The glycerin is not changed, but exerts an influence by which the oxalic acid is decomposed at a lower temperature than would otherwise be required. On distilling the mixture, formic acid and water pass over. To obtain the concentrated acid, it is necessary to saturate it with carbonate of lead, filter, evaporate to a small bulk, collect the formate of lead, dry it, decompose by a current of sulphuretted hydrogen, and separate the syrupy acid; or distil the formate of lead with sulphuric acid.

A solution of formic acid in alcohol is still occasionally employed abroad as a rubefacient under the name of *spiritus formicarum*, prepared by distilling 4 pounds of alcohol from 2 pounds of ants.

Succinic Acid.—Spermaceti, tallow, or margaric acid, if for several days digested, without boiling, with nitric acid of medium strength, yields, on evaporation, succinic acid. It is also prepared by fermentation of impure malate of calcium as follows: Suspend old cheese, 1 part, in water, and digest with the calcium salt, 12 parts, and 40 parts of water, at a temperature below 112° F., for four to six days, until gas ceases to be emitted; the precipitate is now washed, dilute sulphuric acid added to neutralize the carbonate of calcium, the same quantity of acid added and boiled until the precipitate has lost its sandy nature; the liquid is filtered off and evaporated until a pellicle is formed, when the lime is precipitated with sulphuric acid, and the filtrate further evaporated; the crystals may be recrystallized and purified with animal charcoal. It may also be obtained from amber by distillation.

A solution of succinate of ammonium is the only preparation medicinally employed, and it is questionable whether its invigorating action in low states of the nervous system is not mostly due to the oils with which it is associated. The *Prussian Pharmacopœia* gives the following directions for preparing it:—

Liquor Ammoniæ Succinatis.—Rub to 1 ounce succinic acid, 1 scruple rectified oil of amber, dissolve in 8 ounces distilled water, and add 1 ounce (containing 15 grains of Dippel's animal oil), or a sufficient quantity, of pyro-oleous carbonate of ammonia.

Aconitic Acid.—It is obtained by heating citric acid for several hours with muriatic acid, evaporating, and extracting by ether.

By distillation, the following three new acids may be obtained, all of which have the composition $C_5H_6O_4$; itaconic, citraconic, and mesaconic or citracantic acids.

Fumaric or Paramaleic Acid.—By precipitating the clarified juice

of Fumaria officinalis with acetate of lead, decomposing the washed precipitate by sulphuretted hydrogen, and recrystallizing the acid from hot water; or by heating malic acid to 300°.

Maleic or mafuric acid = $C_4H_4O_4$, isomeric with fumaric acid, is obtained by distillation of malic acid, or by heating fumaric to 400°. It differs from the latter by being readily soluble in water, distilling at 350°, and by the insolubility of its lead salt, which, being curdy at first, becomes crystalline on standing.

By fermentation, fumaric and maleic acids are converted into succinic acid.

Acidum Lacticum. (*Lactic Acid.* $H_2C_3H_4O_3$.)

This acid is contained in many old extracts as a product of fermentation of their saccharine constituents, or of malic acid. For medicinal use it is prepared by the so-called lactic fermentation. The following process of Wackenroder is one of the most simple: 25 parts sugar of milk, 20 parts finely powdered chalk, 100 parts skimmed milk, and 200 parts water are digested at about 75°; in six weeks the chalk will be dissolved, the whole is then heated, but not to boiling; the cheese is strained off, pressed, the decanted liquid is clarified by albumen and evaporated to let the lactate of calcium crystallize; the recrystallized salt is decomposed either by sulphuric or by the exact quantity of oxalic acid.

The acid and its iron salt are officinal, and have been of late much used in medicine. It is a syrupy liquid of a sour taste, sp. gr. 1.212.

The diluted acid must not be precipitated by chloride of barium —absence of sulphuric acid; by sulphate of calcium—absence of oxalic acid; by sulphuretted hydrogen—absence of metallic oxides; or after neutralization with ammonia, by oxalate of ammonium—absence of lime: 90 grains of the officinal lactic acid are saturated by not less than 75 grains of bicarbonate of potassium.

Third Group.—Acids representing wholly or in part the Medicinal Virtues of Plants.

The acids arranged in this group have very few chemical properties in common; they are interesting to the physician because they are wholly or in part the active principles of the plants in which they have been generated. If those grouped in division *a* be excepted, the acid properties of most of these acids are not very decided; some of them are unable to decompose the carbonates, and quite a number have been long taken for neutral principles. Of the whole number, phloridzic and santonic acids only have been employed in medicine in their isolated condition; chrysophanic acid is attracting considerable attention as the active principle of our most popular cathartics.

(a) *Connected with Volatile Oils and Resins.*

Angelicic acid, $HC_5H_7O_2$.	In the root of angelica, masterwort, etc. Long colorless prisms, without water of crystallization, odor aromatic, boiling point 374°; little soluble in cold water, easily in boiling water, alcohol, ether, oil of turpentine, and fixed oils.
Guaiacic acid, $HC_6H_7O_3$.	In the resin and wood of guaiacum; colorless scales of vanilla odor, green with Fe_2Cl_3, but not blue by Cl.

(b) *Mostly Bitter Acids, some Poisonous.*

Hederic acid, $C_{15}H_{26}O_4$.	In the seed of common ivy. Insoluble in water and ether; without odor, of acrid taste; colored purple by concentrated sulphuric acid. The salts are mostly gelatinous.
Picrotoxic acid, $C_{12}H_{14}O_5$.	In Cocculus Indicus. Colorless prisms; extremely bitter; very poisonous.
Phloridzic acid, $C_{21}H_{24}C_{10}+H_2O$.	In the bark of many fruit trees, especially the apple tree. Yellowish silky needles, easily soluble in alcohol and boiling water; little in ether and less in cold water; inodorous, taste bitter, and somewhat astringent; fuses at 220°, solid again at 266°, and liquid at 320°.
Chrysophanic acid, $C_{10}H_8O_3$.	In rhubarb root, senna, dock root, Parmelia parietina, etc. Golden yellow needles of metallic lustre, inodorous, nearly tasteless, nearly insoluble in cold water, soluble in alcohol and ether, and in sulphuric acid without decomposition, in alkalies with a dark red color; its salts are very changeable.
Santonic acid, $C_{15}H_{18}O_3$. (Santonine.)	In Levant wormseed, from artemisia santonica, etc. Flat, hexagonal, or feathery prisms, little soluble in cold, soluble in 250 p. boiling water, in 75 p. ether, in 43 p. cold, and 3 p. boiling alcohol; the ethereal and alcoholic solutions are intensely bitter; light colors it yellow, but recrystallization yields it white again; the alcoholic solution colored carmine-red by alkalies.
Caincic acid, $C_{40}H_{64}O_{18}$.	In cahinca root. Chiococca angiafugæ. Fine silky needles; inodorous; tasteless, with an astringent aftertaste; little soluble in ether and water, readily in alcohol; yields kinovin (see neutral prin.) and glucose by alkalies and dilute acids; the salts uncrystallizable.
Polygalic acid, $C_{18}H_{24}O_{15}$	In the root of Polygala amara and senega. White amorphous powder, without odor, tasteless, afterwards very acrid, astringent in the throat, sternutatory, little soluble in cold water, the solution foams like soap-water; easily soluble in alcohol, insoluble in ether; with concentrated sulphuric acid in contact with air it changes yellow, red, dissolves, then blue, grayish, colorless; poisonous, producing difficulty of breathing, vomiting, etc. The salts are uncrystallizable.
Cetracic acid, $C_{18}H_{14}O_7$?	In Iceland moss. Very thin needles, intensely and purely bitter, nearly insoluble in water, soluble in boiling alcohol, little in ether; destroyed by mineral acids, and by boiling its solution in alcohol or its soluble salts.
Anacardic acid, $C_{44}H_{64}O_7$.	In cashew nuts. White, crystalline, fusible at 79°; inodorous; taste aromatic; turns rancid and liquid in air.

Digitalic acid. (?)	In the herb digitalis. Needles of a peculiar odor; not volatile, soluble in water, alcohol, less in ether; its salts soluble but change when dissolved.
Digitaleic acid. (?)	Green needles; taste bitter, acrid, odor aromatic; little soluble in water, more in alcohol and ether, salts yellow or green, insoluble except the alkaline solutions, frothing (from saponin?)
Cornic acid. (?)	In the rootbark of Cornus Florida. Stellate silky scales; bitter; soluble in water and alcohol, precipitated by $2PbO,\overline{Ac}$, and $AgNO_4$.

Angelicic acid may be obtained by the action of potassa on oil of chamomile, imperatorin and peucedanin; it is more advantageously prepared by exhausting 12 parts of angelica root with 1 part hydrate of lime and sufficient water, evaporating, distilling with the addition of sulphuric acid, and redistilling the distillate after saturation with potassa and decomposing with sulphuric acid; large crystals appear after some time, valerianic and acetic acids remain in solution. Its salts are crystallizable, and its compound with ether has the odor of rotten apples. It is decomposed by excess of caustic potassa into acetic and propionic acids.

Guaiacic Acid is obtained by dissolving the resin in 1 part alcohol, filtering, precipitating with concentrated KO, washing and decomposing by HCl.

The resin of guaiacum yields by dry distillation *guaiacene*, a light volatile oil which is an oxide of a camphene, and has the composition of guaiacic acid minus $2CO_2 = C_5H_8O$.

Hederic Acid.—The seeds are freed of fat by ether, afterwards exhausted by boiling alcohol; on cooling, the acid separates in colorless needles or tablets.

Picrotoxic Acid, *Picrotoxin.*—After the fixed oil of cocculus indicus is expressed, the acid crystallizes from the decoction of the residue with diluted muriatic acid.

Phloridzic Acid, *Phloridzin.*—It crystallizes from the tincture of apple-tree bark, prepared with warm diluted alcohol.

It yields formic acid on being treated with sulphuric acid and oxide of manganese; by diluted acids phloretin and sugar, $C_{21}H_{24}O_{10} + H_2O = C_{15}H_{14}O_5 + C_6H_{12}O_6$.

It has been used with asserted success as a substitute for quinia in the treatment of intermittent fevers.

Chrysophanic Acid.—Synonyms of this acid in various states of purity are, parietinic acid, rhein, rhabarbarin, rheumin, rhabarbaric acid, rhaponticin, rumicin, lapathin. It is prepared by extracting rhubarb or Parmelia parietina with weak alkaline alcohol, precipitating by carbonic acid, dissolving in 50 per cent. alcohol containing a little caustic potassa, precipitating by acetic acid, dissolving in boiling alcohol, mixing the filtrate with water and recrystallizing from alcohol.

Investigations performed by Professor Schroff tend to show that the cathartic principle of rhubarb is chrysophanic acid, which is modified in its action by the other constituents of the root, so that while powdered rhubarb acted within twelve hours, Geiger's *rha-*

barbarin purged in nineteen, Brandes' *rhein* in twenty, and pure *chrysophanic acid* in twenty-four hours; on the other hand he found the duration of the activity of rhubarb to be about twenty-four hours, that of rhein and rhabarbarin three, and of chrysophanic acid five days; during this time eight grains of the latter produced twelve thin yellow evacuations, without the least griping. The acid prepared from Parmelia parietina shows no difference from that prepared from rhubarb. The quickness of action of rhubarb in pharmaceutical preparations must be due to excipients or adjuvants which render the chrysophanic acid soluble.

The active vegetable principle of senna, supposed to be chrysophanic acid, has been determined by Dragendorff & Kubly to be a peculiar acid, named by them "cathartic acid." Dr. Martius has not succeeded in completely isolating chrysophanic acid from senna, but the reactions indicate its presence as well as the presence of two or three other bodies first discovered in rhubarb, namely, aporetin, phæoretin, and probably erythroretin.

Winkler's cathartin, found in the ripe fruit of Rhamnus catharticus, is also believed to be identical with this acid in an impure state.

Chrysophanic acid, when taken internally, passes into the urine, where it may be easily recognized by its striking a characteristic red color with alkalies. The same reaction takes place after the administration of rhubarb and senna; with the latter given in the form of infusion or aqueous extract, this reaction would often take place after fifteen minutes and last until twelve hours after the evacuations had taken place.

The root of Rumex obtusifolius, and probably other species, owe their laxative properties to chrysophanic acid. (See *Am. Journ. Pharm.*, xxxi. 153.)

Santoninum, U. S. P. (*Santonin*, *Santonic Acid.*)

This is directed to be prepared from Levant Wormseed (Santonica), 48 troyounces (3 lbs. 5 oz. com.); lime recently slaked and in fine powder, 18 troyounces (1 lb. 3½ oz. com.); animal charcoal, diluted alcohol, alcohol and acetic acid, of each sufficient. The process is as follows: Digest the wormseed and lime with twelve pints of diluted alcohol for 24 hours and express. Repeat the digestion and expression twice with the residue, using the same quantity of diluted alcohol. Mix the tinctures, and reduce the mixture to eight pints by distilling off the alcohol. Then, having filtered, and evaporated to one-half, gradually add acetic acid until in slight excess, stirring during the addition, and set the whole aside for forty-eight hours. Place the resulting crystalline mass upon a funnel loosely stopped, wash it with water, and dry it. Next, boil the dry residue with ten times its weight of alcohol, and, having digested the tincture for several hours with animal charcoal, filter it while hot, and add sufficient hot alcohol, through the filter, to wash the charcoal thoroughly; then set it aside in a dark place to crystallize. Lastly, dry the crystals on bibulous

paper in the dark, and keep them in a well-stopped bottle, protected from the light.

By evaporating the mother-water, more crystals may be obtained.

This is a new officinal, which being made exclusively from a European seed, is itself, perhaps, chiefly imported.

Santonic acid is much employed as a very reliable vermifuge, and often exhibited to children in the form of confection or troches. Dose for children, ½ to 1 grain 2 or 3 times daily. It has been used in 2 to 5 grain doses in retention of urine. Its chief recommendation, as a vermifuge, consists in the smallness of its dose, and its comparative tastelessness. It is thus described in the *Pharmacopœia.*

A colorless substance, crystallizing in shining, flattened prisms, without smell, and nearly tasteless when first put into the mouth, but afterwards bitter. It is not altered by the air, but becomes yellow on exposure to light. It melts when heated, and forms, on cooling, a crystalline mass. When heated somewhat above its melting point, it rises unchanged in dense, white, irritating vapors. Nearly insoluble in cold water, it is dissolved by 250 parts of boiling water. It is soluble in 43 parts of cold and 3 parts of boiling alcohol, and in 75 parts of ether—its alcoholic and ethereal solutions are intensely bitter.

The santonates are decomposed by being boiled with water. The potassa salt is uncrystallizable. The soda salt, which on account of its solubility has been proposed as a substitute for the acid, is obtained by digesting its alcoholic solution with carbonate of sodium, evaporating, redissolving in strong alcohol, and crystallizing. Large crystals are obtained by evaporating spontaneously its concentrated aqueous solution. It contains 74 per cent. santonic acid.

Caincic acid, on which the strong diuretic virtues of cahinca root depend, is obtained by treating the alcoholic extract with water, filtering, adding milk of lime gradually until all bitterness has disappeared, and treating the precipitated cahincate of calcium with alcoholic oxalic acid. This acid was among the rare products exhibited by Merck in the World's Fair of 1862.

Polygalic Acid, *Senegin*, *Polygalin.*—The root is extracted with alcohol, evaporated to syrupy consistence, and this mixed with ether which separates fixed oils, and in which it is nearly insoluble; after some time a precipitate forms which is collected on a filter, dissolved in boiling alcohol, treated with animal charcoal, and filtered. (*See* the paper by Prof. Procter in *Proc. Am. Ph. Assoc.*, 1859, p. 297.)

Cetraric Acid.—Iceland moss is extracted by boiling alcohol and carbonate of potassium, the liquid acidulated with muriatic acid and mixed with four or five volumes of water. The precipitate consists principally of cetraric and lichenstearic acids. It is dissolved in eight or ten times its quantity of boiling weak alcohol and filtered, on cooling the lichenstearic acid crystallizes in quadrangular plates, afterwards the cetraric acid in needles; the needles

are separated from an amorphous body, and several times recrystallized.

Anacardic acid is obtained from the pericarp of cashew-nuts by treating the ethereal extract with water, to separate tannic acid, dissolving in alcohol, and digesting with hydrated oxide of lead; the anacardate of lead is decomposed by sulphuretted hydrogen. The impure acid is purified by washing, recombining with lead, and decomposing by diluted sulphuric acid.

Digitalic Acid.—The alcoholic extract of the aqueous extract of digitalis is treated with ether, which dissolves the acid and digitalin; caustic baryta precipitates digitalate of barium, which by decomposition with sulphuric acid yields the acid.

Digitaleic Acid.—The precipitate of the aqueous extract by acetate of lead is washed, decomposed by carbonate of sodium, the filtrate precipitated by muriatic acid, recrystallized from hot alcohol.

Cornic acid or *Cornine* is prepared by Geiger by exhausting the aqueous extract of Cornus Florida with ethereal alcohol, agitating the solution with some HO,PbO and evaporating the filtrate spontaneously. (*See* Maisch's paper in *Proc. Am. Ph. Assoc.*, 1859, p. 315.)

Fourth Group.—Acids combined with Vegetable Alkalies.

It has not yet been ascertained of all alkaloids in what combinations they occur naturally. The large number of vegetable acids in existence, and the difficulties often attending their complete isolation, make the recognition of an acid in its natural association a matter of no ordinary difficulty, and have led to the proposal of many new names for acids long before known, before their identity with those before discovered had been established beyond doubt. The greater the difficulty in isolating an acid, or the more widely diffused it is throughout organic nature, the greater will be its liability to receive constantly new names from plants hitherto not subjected to a complete analysis. It is only necessary to refer for illustration to malic acid, which has been named at various times after quite a number of plants; under that head, attention has been drawn to various acids, mostly connected with alkaloids, which, by later investigations, have been proved to be malic acid. Of acids treated of in the *second group*, the following would likewise belong to this fourth group; fumaric acid, in Glaucium luteum combined with glaucina; aconitic acid in Aconitum napellus combined with aconitia. Meconic and kinic acids are important on account of some of their reactions.

Chelidonic acid, $C_7H_4O_6$. In celandine with lime, sanguinarina and chererythrina. Colorless needles, soluble in water and alcohol; purple by warm H_2SO_4; the salts colorless; the tribasic salts lemon-yellow.

Meconic acid, $H_3C_7HO_7$. In opium with morphia. Colorless pearly scales or prisms; taste faintly acid and astringent; little soluble in cold water and ether, soluble in hot water and alcohol. Sesqui-salts of iron are colored deep red by a trace of acid, the coloration is not affected by boiling, dilute acids, or chloride of gold (difference from sulphocyanide); this test is characteristic of the presence of opium.

Veratric acid, $C_9H_{10}O_4$.	In cevadilla seed, with veratria. Four-sided needles; sublimable, soluble in alcohol and boiling water. The veratrates of the alkalies are very crystallizable and soluble in water and alcohol.
Columbic acid, $C_{21}H_{22}O_7$.	In colombo root, with berberine. Straw-yellow powder nearly insoluble in water, little in ether, easily in alcohol; the latter solution precipitated by Pb, $\overline{Ac}$ but not by Cu, $\overline{Ac}$.
Kinic acid, $HC_7H_{11}O_6$.	In Peruvian bark with quinia, cinchonia, in seeds of coffee with caffeina. Oblique rhombic prisms, soluble slowly in $2\frac{1}{2}$ parts cold water, little in alcohol, scarcely in ether; most salts are soluble. Heated over its melting point, decomposed into benzeic and phenylic acids, salicylous acid, hydrokinone and benzol: with MnO_2 and H_2SO_4 converted into kinone, carbonic and formic acids.

Chelidonic Acid.—Celandine contains, while young, chiefly malic acid; when in flower, malic acid has disappeared, and the juice contains chelidonic acid. To prepare it, the juice is coagulated by heat, the filtrate, after being acidulated with nitric acid, is precipitated by nitrate of lead, which must not be added in excess; the precipitate is decomposed by hydrosulphuric acid, the free acid combined with lime, the salt recrystallized, decomposed by carbonate of ammonium, and afterwards by muriatic acid.

Meconic Acid.—The meconate of calcium obtained on the manufacture of morphia is dissolved in dilute muriatic acid, and heated to 195°, when, on cooling, acid meconate of calcium crystallizes, which is treated again in the same way; meconic acid now crystallizes, is purified by repeated crystallizations, combined with ammonia or potassa, and lastly precipitated by muriatic acid.

Komenic acid, $C_6H_4O_5 = C_7H_4O_7 - CO_2$, by heating meconic acid to 390°, or by boiling its solution, particularly with dilute muriatic acid.

Hard warty crystals, colorless, insoluble in absolute alcohol, slight acid taste; bibasic.

Parakomenic acid, $C_6H_4O_5$, in small quantity, on the dry distillation of the former. Feathery needles, very acid taste; bibasic.

Pyromeconic acid, $C_5H_4O_3 = C_6H_4O_5 - CO_2$, by the dry distillation of meconic or komenic acid. Crystallizes in colorless, lustrous needles, scales, or octohedrons; fuses at 257°; sublimes at 212° completely, is easily soluble in alcohol and water, monobasic, a weak acid.

All these derivatives of meconic acid show its characteristic coloration with sesquisalts of iron.

Veratric Acid.—The alcoholic tincture of cevadilla seed is acidulated with sulphuric acid and precipitated by lime, the filtrate is distilled and decomposed by an acid.

Columbic Acid.—The alcoholic extract of columbo root is treated with lime, and the lime salt decomposed by muriatic acid.

Kinic Acid.—The bark is exhausted by acidulated water, the alkalies precipitated by a little lime, more lime precipitates the cinchotannic acid and coloring matter, the filtrate is evaporated, the crystals of kinate of lime decolorized with animal charcoal, and decomposed by oxalic acid.

This acid, which has been prepared from huckleberry leaves, oc-

curs probably in many plants, since the extract of coffee leaves and seed, Paraguay tea, Ligustrum vulgare, Hedera helix, various oaks, elms, and ashes yield with MnO_2 and H_2SO_4, the following compound.

Kinone, $C_6H_4O_2$, golden-yellow prisms, odor of iodine, fusible, volatilizable, little soluble in cold water, soluble in alcohol and ether; with sulphuretted hydrogen it turns immediately red, precipitates floccules, which, after drying, are olive-green.

Hydrokinone, $C_6H_6O_2$, by dry distillation of kinic acid, or from kinone by the action of sulphurous or hydriodic acids. Colorless prisms, inodorous, fusible, volatile; easily soluble in water and alcohol. Oxidizing agents precipitate needles of

Green hydrokinone, $C_6H_6O_2 + C_6H_4O_2$, of a beautiful green metallic lustre; fusible, but decomposed on volatilizing, little soluble in water, more in alcohol.

Fifth Group.—Acids derived from or Yielding Essential Oils.

But few of the numerous essential oils naturally contain acids, and have, in consequence thereof, an acid reaction; most oils, however, on exposure to the atmosphere, become oxidized, and while they assume a thicker consistence, their chemical nature is partly changed, and they now, in alcoholic solution, impart a red color, more or less decidedly, to blue litmus paper—they have become resinified. A similar change takes place by subjecting the essential oils to the influence of nitric or chromic acid, or other strong oxidizing agents. Thus the essential oils yield a large number of acids, mostly of a nature which may be termed resinous. The compounds from which essential oils are generated in the plants are not known; but several principles have been discovered and isolated, which under various circumstances are split into two or more bodies, one of which has all the characteristics of an essential oil. But one of these principles is of an acid nature, the others will be found under the head of neutral principles. The following embraces those acids only that are important in a medical point of view, or interesting on account of their relation to other proximate principles.

(a) *Acids occurring in the freshly-distilled Crude Oils.*

Hydrocyanic acid, HNC.	In the volatile oils of amygdaleæ and pomaceæ. (*See* Nitrogenated Oils.) The anhydrous acid is colorless, limpid, crystallizes at 5° F.; sp. gr. .69; decomposed on keeping; extremely poisonous.
Salicylous acid, $C_7H_8O_2$.	The volatile oil of herbaceous plants of the genus Spiræa; oily liquid, colorless or reddish, of an agreeable aromatic odor and burning taste; sp. gr. 1.17; it freezes at 5° F., and boils at 340° F.
Methyl-salicylic acid, $C_6H_4(OH_3)O,COH$.	The oxygenated part of oil of wintergreen; colorless or reddish-yellow oil of a well-known odor; sp. gr. 1.18; boiling point 252°.
Caryophyllic acid, $C_{10}H_{12}O_2$.	The oxygenated part of oil of cloves; colorless oil, of 1.079 sp. gr.; boiling point 484°; odor and taste of cloves; resinifies in contact with the air. The caryophyllates of alkalies and alkaline earths are crystallizable; metallic salts are either precipitated or colored blue, violet, or green.

(b) *Products of Oxidation by the Atmosphere.*

Valerianic acid, $C_5H_{10}O_2$. — From valerol in oil of valerian and valerian root; colorless oily liquid, of a disagreeable odor of valerian and old cheese, and a similar acid taste; its sp. gr. is .937; its boiling point 347° F.; it is inflammable, dissolves in 30 parts cold water, and in all proportions of alcohol and ether; it dissolves camphor and some resins.

Benzoic acid, $C_7H_8O_2$. — In old oil of bitter almonds, benzoin with cinnamic acid; inodorous needles or scales; when sublimed from benzoin of a faint balsamic odor; taste slight, afterwards acrid; fusible at 248°; boiling at 462°; soluble in 200 p. cold and 25 boiling water; more in alcohol and ether.

Cinnamic acid, $C_9H_8O_2$. — In old oil of cinnamon, storax, Tolu, Peru balsam, etc. Resembles the former in physical properties. Colorless prismatic and scaly crystals, melting at 264° F., boiling and distilling at 655° F.; little soluble in cold water (less than benzoic acid), easily soluble in alcohol.

(c) *Acids obtainable by artificial oxidation of Volatile Oils.*

Anisic acid, $C_8H_8O_3$. — From oil of anise and fennel by oxidation with 6 p. $K2CrO_4$ and H_2SO_4; large colorless prisms, nearly insoluble in cold water, easily in boiling water, in alcohol, and ether. Melts at 347° F., sublimes at higher temperature in white needles; distilled over baryta, is decomposed into carbonic acid and anisol, $C_8H_8O_3 = CO_2 + C_7,H_8,O$. Its salts are crystallizable.

Pelargonic acid, $C_9H_{18}O_2$. — From oil of rue by diluted NO_5, and in oil of rose geranium; colorless oil, of a peculiar odor; crystallizes in cold weather and boils at 500°; its compound with ether is interesting for its agreeable odor of quinces. (*See* Pelargonic Ether.)

Rutinic or caprinic acid, $C_{10}H_{19}O_2$. — From oil of rue by HNO_3, and in the butter of cows and goats, in cod-liver oil, cocoanut oil, and some fusel oils; white crystalline masses, of a peculiar "buck's" odor, easily soluble in alcohol and ether.

Angelicic acid, $C_5H_7O_2$ — From oil of chamomile by KO. (*See* Third Group.)

(d) *Acids obtained from Empyreumatic Oils*

Phenylic acid, C_6H_5HO. — In coal tar; from salicylic and kinic acids, and some resins; in castor, and the urine of many domestic animals. Long colorless needles, melting at 95°, boiling at 369° F.; not very soluble in water, in all proportions in alcohol and ether, soluble in concentrated acetic acid. By nitric acid it is converted into picric acid.

Carbazotic acid, $HCH_2(NO_2)_3O$. — By HNO_3 from salicin and its derivatives, from coumarin, phloridzic, and phenylic acids, silk, indigo, and coal tar; yellow scales or octahedrons, soluble in 86 parts of water of 60°, easily soluble in alcohol and ether, explosive when suddenly heated; it colors the skin yellow, is very bitter, and is a dye for silk and wool, but not for cotton. Its salts are yellow, crystallizable, very bitter, soluble, and explosive by heating.

Ferrocyanide of Potassium and Hydrocyanic Acid.

Hydrocyanic or prussic acid, as formed by a reaction between amygdalin and emulsin, and as an ingredient in the volatile oils distilled from many plants belonging to the natural family of Rosaceæ, has already been referred to (*see* Nitrogenated Volatile Oils; *also* Amygdalin), but for pharmaceutical use, the acid is prepared artificially, and the *U. S. Pharmacopœia* gives two processes, the starting-point for each being the decomposition of ferrocyanide of potassium by sulphuric acid.

Potassii ferrocyanidum, U. S. P., *yellow prussiate of potassium*, is only made on a large scale from animal matter free of bones. This is either first subjected to dry distillation in order to gain part of the nitrogen as ammonia, and the remaining charcoal, which is highly charged with nitrogen, is fused together with small fragments of iron and potash; or the first part of the process being omitted, the animal matter is at once subjected to a red heat in conjunction with potash and iron. After long-continued heating and stirring, a combination has been effected, the fused mass now containing cyanide of potassium, which, when dissolved in water, combines with finely-divided iron, and crystallizes into large yellow tabular prisms, which have a sweetish bitter taste, are soluble in four parts of cold water, and insoluble in alcohol.

They are composed of one equivalent of cyanide of potassium and one of cyanide of iron, $=K_4FeCy_6$. The water of crystallization is given off in a dry, warm atmosphere, and the crystals become white and pulverulent. This salt has an extensive use in the arts, and is employed for the preparation of ferrocyanide of iron, hydrocyanic acid, and all its compounds.

This salt is little used in medicine; it is not poisonous, but in very large doses is apt to produce vertigo, coldness, and fainting; it has been recommended as an alterative, antiphlogistic, and tonic astringent in the dose of from ten to twenty grains internally, and externally, in an eye-salve, composed of from five to twenty grains to one drachm of cacao-butter.

The commercial salt, though not chemically pure, is sufficiently pure, if it is well crystallized, and dissolves in two parts of boiling water.

Argenti Cyanidum, U. S.; *Cyanide of Silver*.—According to the *Pharmacopœia*, the hydrocyanic acid, produced from two troyounces of ferrocyanide of potassium, as below, is conducted into a solution of two ounces of nitrate of silver.

The cyanide of silver is precipitated as a white, tasteless, inodorous powder, which is darkened by the light, is insoluble in diluted nitric acid, but decomposed by it at a boiling temperature. It is soluble in ammonia, and in cyanide of potassium, and consists of one equiv. of cyanogen, and one of silver=AgCy. It is used sometimes externally in ointments as an anti-syphilitic.

Acidum Hydrocyanicum Dilutum, U. S. P.—From the above two salts the *Pharmacopœia* gives two distinct processes, the first of

which is intended for making hydrocyanic acid in larger quantities, while the second process is given for its extemporaneous preparation, and is particularly applicable for the use of the physician.

First Process.—Take of ferrocyanide of potassium ℥ij, sulphuric acid ℥iss, distilled water q. s. Mix the acid with distilled water f℥iv, and pour the mixture when cool into a glass retort. To this add the ferrocyanide of potassium, previously dissolved in distilled water, f℥x. Pour of the distilled water f℥viij into a cooled receiver; and, having attached this to the retort, distil by means of a sand-bath, with a moderate heat, f℥vj. Lastly, add to the product, distilled water f℥v, or q. s. to render the diluted hydrocyanic acid of such strength that 12.7 grains of nitrate of silver dissolved in distilled water may be accurately saturated by 100 grains of the acid, and give 10 grains of the cyanide of silver, which, corresponding with 20 per cent. of its own weight of anhydrous hydrocyanic acid, indicates 2 grains, or 2 per cent. of it in 100 grains of the officinal acid.

The difficulties in this process are twofold: 1st. It is difficult to conduct the distillation in an ordinary uncovered retort on account of the excessive bumping occasioned by the escape of the acid vapor through the mixed liquid and precipitate; and, 2d. It is troublesome to adjust the strength of the distillate to the officinal standard. The first of these difficulties may be overcome by placing the retort in a sand-bath, or setting it upon fine wire-cloth, introducing at the same time in the liquid a piece of thick platinum wire. The precision necessary to be observed in regard to the strength of so powerful a medicine as this, and the impossibility of regulating by the proportions employed the amount of the acid generated and absorbed by the water in the receiver, make it necessary to determine its strength by experiment at each operation. This may be accomplished by testing, say 100 grains of the acid distillate with nitrate of silver before diluting it, carefully washing the resulting cyanide of silver, drying and weighing it, then calculating the degree of dilution required by the weight of this precipitate. If of proper strength, this would be 10 grains, as above, but in this experiment of course a larger yield would be obtained. The equation would then be as follows: As the known weight of the precipitate from acid of standard strength, is to the weight of cyanide obtained from the distillate, so is the quantity of the acid weighed to the quantity to be obtained by dilution. Suppose the precipitate to have weighed 11.5 grains—then 10 : 11.5 : : 100 : 115; or to every 100 grains of the distillate 15 grains of water must be added, to make the officinal diluted hydrocyanic acid.

For ascertaining the strength of liquids containing hydrocyanic acid, by volumetric analysis, see a paper by Dr. W. H. Pile, in *Am. Journ. Phar.*, 1862, p. 130, where also a neat graduated tube, made for this purpose, is figured. The process is Liebig's, and is based on the formation of a soluble double cyanide of potassium and silver, before chloride of silver is formed.

The plan recommended to the inexperienced is, to saturate the

acid which comes over by the officinal process without special reference to the quantity of water in the receiver, with nitrate of silver, as stated above, to form the officinal cyanide of silver, and further proceed, after carefully washing and drying the product, by the second process of the *Pharmacopœia*, as follows:—

Second Process for Diluted Hydrocyanic Acid.

Take of	Cyanide of silver	Fifty grains and a half.
	Muriatic acid	Forty-one grains.
	Distilled water	One fluidounce.

Mix the muriatic acid with the distilled water, add the cyanide of silver, and shake the whole in a well-stoppered vial; when the insoluble matter has subsided, pour off the clear liquid and keep it for use. In preparing this medicine, a slight excess of muriatic acid is not objectionable, giving it greater stability. The only apparent objection to this process is its expensiveness; this is, however, less than would at first appear. The reaction between muriatic acid and the cyanide results in the production of hydrocyanic acid and chloride of silver, thus—$AgCy + HCl = HCy + AgCl$. Now, the chloride of silver is convertible into pure metallic silver by the introduction into it while in the condition of a moist powder, of a strip of zinc, which abstracts the chlorine, the chloride of zinc becoming dissolved, and the pure silver remaining as a gray-colored spongy mass or powder, which, on being washed and treated with nitric acid, yields the soluble nitrate ready for any further use.

The practitioner, who wishes to be prepared for every demand of his practice, may, with advantage, supply himself with a suitable f℥j vial, containing 50½ grains cyanide of silver, to which the mixed muriatic acid and water may be added when the occasion arises.

The diluted acid prepared as above is a colorless liquid occasionally having, from the presence of iron, a slight blue tint, of a peculiar odor and taste; it is entirely volatilized by heat, and decomposes under the influence of light. It is usually put up in one-ounce ground-stoppered vials, wrapped in dark blue or black paper, and sometimes inclosed in a tin case. It contains two per cent. of anhydrous HCy. Its use in medicine has been avoided by some practitioners, on account of the violent poisonous character of the anhydrous or concentrated acid; but in the diluted form, in which it is officinal, it is no more dangerous than many other remedies constantly prescribed, and, notwithstanding the alleged variable strength of the commercial article, I believe it will be found as nearly uniform as most other pharmaceutical preparations prepared by manufacturers.

As a sedative and antispasmodic, it is a favorite with some practitioners, who employ it simply mixed with mucilage, or with the galenical preparations of digitalis, valerian, etc. It should not be prescribed with strong alkaline, ferruginous, or other metallic salts.

In this country, no stronger hydrocyanic acid is used than the

officinal; in other countries, however, its strength varies materially. The acid of the *London*, *Dublin*, and *Prussian Pharmacopœias* is of about the same strength as our own, that of the *Edinburgh Pharmacopœia* contains about 3¼ per cent., Scheele's acid 5 per cent., and some European *Pharmacopœias* even a much larger proportion of anhydrous acid. The dose of our officinal acid, being ♏ij to ♏v, is so small that there is no necessity for employing a stronger acid in formulas, which would be liable to lead to dangerous mistakes; besides, it must be remarked that strong acids are very prone to spontaneous decomposition, while that of the officinal strength, if not exposed to the light or to a continued high temperature, keeps well for a considerable time. Of course the vials are to be well stoppered on account of the volatility of the acid.

Potassii Cyanidum, U. S. P.; *Cyanide of Potassium.*—This salt may be mentioned in this place, as having all the medicinal properties of hydrocyanic acid; it is given as a substitute for it. It is prepared by fusing ferrocyanide of potassium with carbonate of potassium until effervescence ceases, when the clear liquid is poured off the precipitated oxide of iron, and, immediately after cooling, put into well-stoppered bottles. It is then in white fused masses of a powerful caustic taste, and a composition which is expressed by the formula KCy, but thus prepared it is contaminated by carbonate and cyanate of potassium.

The pure cyanide is equal to ⅔ of its weight of hydrocyanic acid, the officinal to somewhat less. The dose is $\frac{1}{16}$ grain, which, with proper care, may be gradually increased to ½ grain; it is given dissolved in alcohol or water.

It is a useful chemical agent for removing the stains of nitrate of silver and durable ink, and its utility as a solvent for metallic oxides is well known in electro-metallurgy and photography.

Salicylous or spirous acid is artificially obtained by oxidation of salicin or populin and by fermentation of helicin. 3 parts salicin are mixed with 3 parts bichromate of potassium, and 24 parts water; to this 4½ parts sulphuric acid in 12 parts water are added, and after the reaction has ceased, heat is applied, and distilled as long as with the water an oily liquid comes over, which is taken up by ether and left after its evaporation.

The salicylites, when kept moist, are decomposed, acquiring a rose odor; this reaction has been proposed for the formation of an artificial rose-water.

If salicylous acid is heated with potassa, it is converted into *salicylic or spiric acid*, $C_7H_6O_3$, which is of importance as the acid contained in the following:—

Methyl-salicylic acid, or oil of wintergreen, $CH_3C_7H_5O_3 = C_8H_8O_3$, is the oil obtained by distillation with water from Gaultheria procumbens. By distillation with an excess of baryta it is converted into carbolate of oxide of methyle, while by the dry distillation of an alkaline or earthy salicylate, a carbonate and carbolic acid is formed, $C_7H_6O_3 = CO_2 + C_6H_6O$ (carbolic acid).

Caryophyllic or Eugenic Acid.—If oil of cloves is treated with

solution of potassa or soda, and the light carbo-hydrogen distilled off, the acid may be easily separated by a mineral acid.

Acidum Valerianicum, U. S. P.

This important acid, which is developed spontaneously by the oxidation of valerol, one of the ingredients of oil of valerian, is also met with in the root of Angelica archangelica, in the inner bark of Sambucus niger, in assafœtida, etc., and is artificially obtained by the oxidation of protein compounds, some fatty acids, and particularly of amylic alcohol or fusel oil. The *Pharmacopœia* prepares it from valerianate of sodium by dissolving 8 troyounces in 3 fluidounces of water and decomposing it by $3\frac{1}{2}$ troyounces of sulphuric acid; the oily layer is repeatedly agitated with strong sulphuric acid until its specific gravity is reduced to below .950, when it is distilled and only that portion preserved which is not over .940 sp. gr.

Valerianic acid is a colorless oily liquid, repulsive odor, pungent, sour, acrid, disagreeable taste. Sp. gr. .933. Boils at 270°. Soluble in 30 parts of water.

If agitated with water it takes up from 20 to 25 per cent. water without losing its oily condition, and is now converted into the bihydrate, $HC_5H_9O_2 + 2H_2O$, which has a specific gravity of .950 and boils at 270°.

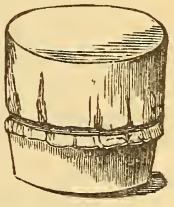
The salts have an unctuous touch, and are inodorous when perfectly dry, but mostly have the odor of the acid; they revolve when thrown upon water in a crystallized state, like the butyrates. Most of them are soluble in water or alcohol, or in both liquids, and have a sweet taste.

The following salts have been used medicinally: the valerianate of ammonium, zinc, iron, bismuth, morphia, quinia, and atropia. See the several heads for descriptions of these.

Acidum Benzoicum, U. S. P.

This, with cinnamic acid, is considered characteristic of the class of medicines called balsams. The two acids are closely allied in their chemical nature, as has been already shown; they are also related to salicylic and allied acids.

Fig. 178.



Benzoic acid apparatus.

For medicinal use it is readily obtained from benzoin by sublimation. For this experiment, which is an interesting one to the pharmaceutical student, the following simple directions are to be observed. Select an iron or tinned iron pan or cup—a common pint cup, without a handle, will answer—and, having covered the bottom with some powdered benzoin mixed with sand, stretch over the top of it a piece of porous paper, which may be secured at the edge by a string, but preferably by glue or some firm paste. Now fold a tall conical or straight-sided cap of the diameter of the pan, and tie it, or cement it securely round the upper edge, and set the whole

in a sand-bath, or over a slow and will-regulated source of heat, leaving it for several hours. On removing the cap, it will be found to contain brilliant white feathery crystals of benzoic acid. The residue in the cup, by being again powdered, mixed with sand, and heated, will yield another though a less abundant and less beautiful crop of crystals.

The process of Scheele consists in boiling the balsam with hydrate of lime, and treating the benzoate of calcium thus formed with muriatic acid. Thus procured, benzoic acid has but little odor, and is ill adapted to the uses to which it is usually applied in medicine and pharmacy. Sometimes the process of sublimation is resorted to at first, and from the residue the remaining acid is extracted by Scheele's process, after which the whole is mixed.

The virtues of the acid are, partly at least, dependent on the odorous principles with which it is associated. Its salts have no smell if prepared from the chemically pure acid, but they retain some of the odor of the officinal acid if prepared from it. Of the salts only the benzoates of ammonium and of sodium have been occasionally employed.

Benzoic acid, if distilled with caustic potassa in excess, is converted into carbonic acid and benzol, $C_7H_6O_2 = CO_2 + C_6H_6$; in the animal organism it is changed into hippuric acid, from which it may be reproduced on boiling with muriatic acid; hippuric acid occurs naturally in the urine of herbivorous animals, and from this source the German article, occasionally met with in our commerce, is derived; it has frequently a peculiar urinous odor, and quite a different appearance from the sublimed article, having been crystallized from an aqueous solution.

Detection of Impurities.—All fixed impurities are left behind on volatilizing some of the acid; hippuric acid is detected by its odor, by leaving charcoal on heating, and by evolving ammonia on heating it with lime; cinnamic acid imparts the odor of bitter almonds to the distillate, with bichromate of potassium and sulphuric acid.

Benzoin is frequently met with in commerce, which contains little or no benzoic acid, it being partly or wholly replaced by cinnamic acid; though unfit for the preparation of benzoic acid by sublimation, it may still be of excellent quality for other pharmaceutical preparations, and for the use of perfumers.

Cinnamic Acid.—To prepare this acid, liquid storax is first distilled with water, to obtain styrol, afterwards treated with carbonate of sodium (residue is styracin); the solution is evaporated, decomposed by muriatic acid, the cinnamic acid after washing recrystallized, and the last impure portions are treated again with soda. In a similar way it is obtained from Tolu balsam (here the residue is Toluol). With excess of baryta or lime it is converted into carbonic acid and cinnamen (C_8H_8); with bichromate of potassium and sulphuric acid into oil of bitter almonds (principal distinction from benzoic acid), and by distillation with hypochlorite of sodium into a chlorinated volatile oil of agreeable odor. When

fused with hydrate of potassa it is decomposed into acetic and benzoic acids.

Acidum Carbolicum, U. S. P.

Carbolic Acid, *Phenic Acid*, *Phenylic Alcohol*.—This substance has been introduced into the list of Materia Medica, in the last edition of the *U. S. Pharmacopœia*. It is defined to be a solid substance obtained from the products of the distillation of coal tar between the temperatures of 300° and 400°.

In the last edition of this work it was stated that the source of supply of creasote was indiscriminately the various kinds of tar, especially that obtained from bituminous coal, without pointing out in a marked manner the difference between them. Since then the investigations which chemists had been prosecuting for some time have been published, and from their labors some of the most interesting and beautiful applications of modern science have resulted.

The following table will show the difference between creasote and carbolic acid, and in such a manner as to clearly place them before the mind of the student:—

Creasote.	Carbolic Acid.
A colorless, oily, neutral liquid.	A solid crystalline substance.
Boils at 397°.	Boils at from 359° to 367°.
Does not congeal at 17° below zero.	Solid at ordinary temperatures.
Sp. gr. 1.046.	Sp. gr. 1.065.
Does not coagulate collodion when mixed with it.	Coagulates collodion when its solution is mixed with it.
If a splinter of pine wood be immersed in an alkaline solution of creasote, dried, and then dipped into muriatic acid, it does not become blue.	A splinter of pine wood, dipped first in an alkaline solution of carbolic acid, dried, and then immersed in muriatic acid, will become of a deep-blue color in about half an hour.
Sparingly soluble in water, requiring 80 parts.	Soluble in from 20 to 33 parts of water, the purest being most soluble.
Formula $C_8H_{10}O_2$.	Formula C_6H_5HO.

The uses of carbolic acid are, as will be readily surmised, much the same as those of creasote; it is employed as a caustic at times; its solution is used in toothache, in the same way as creasote.

A plaster of carbolic acid has been suggested by Joseph Hirsh, of Chicago, formed by spreading carbolate of glycerin on cloth, tissue paper, or other suitable surface. A plastic surgical dressing has been proposed by Dr. T. E. Jenkins, made by kneading 47 parts of prepared chalk with 17 parts of a mixture of 4 parts of glycerin and 1 part of carbolic acid.

The following are several formulas, which are to be relied on as emanating from F. Crace Calvert, of Manchester, England:—

As a Caustic.—Melt the acid by placing the bottle in hot water, and, when melted, add one-twentieth of its bulk of water. It will then remain permanently fluid, and can be diluted as required.

As a Lotion, for External Use.—Add 1 part of acid to 30 parts of boiling water, agitate well, and filter.

For Dressings.—It is advisable that the acid should be dissolved in either pure sweet olive oil, or almond oil, or glycerin.

For Burns and Scalds.—A mixture of 1 part acid and 6 parts pure olive oil is most frequently employed.

Carbolic acid, when dissolved in glycerin, can readily be diluted to any degree of strength as required.

An extra pure acid is sold for internal purposes; it has but a very faint odor, and no objectionable taste, and is specially recommended.

Its principal use is, however, as a disinfectant, and it is perhaps one of the most efficient of the various liquid purifiers known; but while this is the case in regard to the article as ordinarily used, it must be remembered that the ordinary preparation is a mixture in variable proportions of phenylic and cresylic alcohols, and from the experiments of Dr. E. R. Squibb, it would seem that cresylic alcohol is at least double the strength of phenyl alcohol for the purpose of destroying fungous growths. For fuller information on this subject, see the paper of Dr. Squibb, in *Proc. Amer. Ph. Asso.*, vol. xvi. p. 429.

The products of coal tar are thus summed up in the 14th edition of the *U. S. Dispensatory:*—

Six solids: carbon, naphthaline, and paraffin being the most important.

Liquids: which may be subdivided into three classes—acids, neutrals, and bases:—

a. Acids are: carbolic or phenic, acetic, butyric, rosolic, and bumolic. Of these the three first named are by far the most important.

b. Neutral: water, essence of tar, light oil of tar, heavy oil of tar, benzol, toluol, cumol, cymol, propyl, butyl, amyl, caproyl, hexylene, heptyline. Of these the most interesting are benzol, light and heavy oil of tar, essence of tar, and toluol.

c. Bases: ammonia, methylamine, ethylamine, anilin, quinolin, picolin, toluidin, lutidin, cumidin, pyrrhol, and phætin. Of these the most important are ammonia and anilin.

Gases: hydrogen, carburetted hydrogen, bicarburetted hydrogen, and various other carbo-hydrogens, carbonic oxide, sulphuret of carbon, carbonic acid, hydrosulphuric acid, hydrocyanic acid.

Among this long list of derivatives, carbolic acid is that which is most important in a pharmaceutical point of view, which seems to render the notice of these products in this place proper, as most of them have no further pharmaceutic interest.

The other products of coal tar that deserve notice from their intimate relation to pharmacy are, first, benzine, which is obtained from the light oil of tar, or coal naphtha as it is termed, this being derived from the first distillation of coal tar, at a temperature not above 390°, and when the distillate has attained a sp. gr. of .815 to .830, the process must be suspended. The benzine is obtained from this coal naphtha by purifying, by mixing it with 5 per cent. of H_2SO_4, permitting it to rest for a day that the acid and impurities may settle, and then adding 2 per cent. of a solution of caustic soda,

sp. gr. 1.382, to neutralize any remaining acid, and distilling with a current of steam.

Benzine is a light transparent liquid, of a peculiar penetrating odor recalling that of gas tar, sp. gr. varying from .815° to .820°. It is not a pure definite chemical product, and must be carefully distinguished from benzole, which is a definite compound of the formula C_6H_5H, and sp. gr. .850. The principal uses of benzine in pharmacy depend upon its great solvent powers over fatty matters, resinous substances, etc. It has been suggested as a substitute for ether in the preparation of some of the oleoresins, but experiments thus far are not conclusively in its favor. It is much used as a detergent for removing grease from textile fabrics, and forms the basis of most preparations sold for this purpose.

After the light oil of tar or coal naphtha has been separated, the heat is increased, and the distillate now has a sp. gr. of .880 to .885. This is purified by H_2SO_4 and one of the fixed alkalies and redistillation, 10 per cent. of acid and 6 per cent. of soda being used. The heavy oil thus purified is largely consumed for illuminating purposes; after the heavy oil has been drawn off there remains in the still while warm a semifluid mass, consisting largely of paraffine and naphthaline. The former of these is largely consumed in the manufacture of candles, and has been recommended as a substitute for wax in pharmaceutical preparations, but from the experiments of the late Mr. C. T. Carney, it was found to impart a granular character when used to the exclusion of wax. In this opinion he is supported by Mr. J. F. Babcock.

It is from the alkaline and acid liquors obtained in the various purifying processes that the acids and bases above noticed are obtained, and among them anilin has of late years assumed an importance in the arts rivalling almost any of those depending upon chemical research.

Picric Acid, *Carbazotic Acid*, *Welter's Bitters.*—The cheapest method of preparing it is from coal tar, but from indigo it is better obtained in a pure state.—1 part indigo is boiled with 10 to 12 parts of nitric acid, specific gravity 1.43, gradually added until nitrous acid fumes cease to be evolved; the picric acid crystallizes on cooling, and is purified by combining with an alkaloid and precipitating by nitric acid.

It precipitates gelatine, and the solution of its soda salt is a reagent for potassa, which salt is but sparingly soluble.

It has been occasionally used in medicine, and is said to be employed in France in making beer, in place of hops. (*See* Potassii Picras.)

(e) *Acids yielding Essential Oils.*

Myronic acid, $C_{10}H_{19}NS_2O_{10}$, in the form of a potassa salt is contained in black mustard seed, from which it is obtained by exhausting it, first with alcohol, afterwards with water; the last solution is evaporated to a syrup, freed from gum and mucilage by a little alcohol, and evaporated spontaneously to crystallize. The

salt is in colorless needles of a cooling taste, readily soluble in water but insoluble in strong alcohol. Its rational composition is probably $KHSO_3 + C_3H_5CNS$ (oil of mustard) $+ C_6H_{12}O_6H_2O$ (grape sugar).

The acid forms a colorless syrup of acid reaction and bitter taste, soluble in water and alcohol, but insoluble in ether. *Myrosin* is the ferment of black and white mustard seed, which decomposes the acid, thus yielding oil of black mustard.

Sixth Group.—Astringent and allied Acids.

These acids are widely diffused throughout the vegetable kingdom, occurring more rarely in annual plants, but are met with in most perennials, generally in the bark, in the leaves, and morbid excrescences, frequently also in the wood and fruit. They are all with two exceptions uncrystallizable, inodorous, of an astringent taste, and soluble in water and alcohol. The solutions are precipitated by gelatin and albumen, most metallic oxides and the vegetable alkaloids; iron salts are generally rendered dark green, blue, or black. They are weak acids, and if kept in a moist state, are rapidly changed in contact with the air; their salts are quickly darkened while in solution, or, if insoluble, while being washed upon a filter. Owing to this property, their composition and the nature of their changes are, in many cases, still a matter of controversy.

Medical Properties.—The relative utility of tannic and gallic acids, which are too apt to be confounded by physicians, depends upon the fact that the former acts directly upon the mucous membrane with which it comes in contact, arresting hemorrhage or other excessive discharge by its direct effect on the gelatin contained in them. It is hence a direct and powerful styptic, while gallic acid, by entering the circulation, produces an astringent and tonic impression upon the more remote organs which cannot be directly impressed. The dose of tannic acid is from two to ten grains, that of gallic acid from five to twenty, several times a day. The former is much used in ointments as a substitute for powdered galls, in about one-fourth the quantity, and is also well adapted to astringent injections instead of the less soluble vegetable astringents. Its action is considered somewhat different (harsher than that of the modified forms of tannic acid contained in kino, krameria, cinchona, etc.

The list which follows contains the names of different vegetable astringents owing their activity wholly or in part to gallic or some of the modified forms of tannic acid.

List of Vegetable or Tannic Acid Astringents.

Acacia cochliacarpa; the bark. Brazil bark; cortex astringens Brasiliensis.
Bistorta; root of Polygonum bistorta. Bistort.
Carya; bark of C. alba and other species. Hickory bark.
Catechu; extract of wood of Acacia catechu. Catechu.
Chimaphila; leaves of C. umbellata. Pipsissewa.
Cinchona; bark of different species of Cinchona. Peruvian bark.

Diospyros ; unripe fruit of D. Virginiana. Persimmon. Bark also used.
Epigæa; leaves of E. repens. Trailing arbutus.
Galla ; morbid excrescence in Quercus infectoria. Galls.
Geranium ; rhizoma of G. maculatum. Cranesbill.
Geum ; root of G. rivale. Water avens.
Granati fructus cortex ; from Punica granatum. Pomegranate.
" radicis cortex ; " " "
Hamamelis; bark and leaves of H. Virginiana. Witchhazel.
Hæmatoxylon ; wood of H. Campechianum. Logwood.
Heuchera ; root of H. Americana. Alum root.
Hippocastanum; bark of Æsculus H. Horsechestnut bark.
Ilex; bark and leaves of Ilex opaca. American holly.
*Juglans,** leaves and rind (pericarp) of J. cinerea and other species.
Kalmia; leaves of K. latifolia. Mountain laurel.
Kino ; inspissated juice of various plants. Kino.
Krameria ; root of K. triandra. Rhatany.
Matico ; leaves of Artanthe elongata. Matico.
Monesia; extract from Chrysophyllum glyciphlæum. Extract of monesia.
Prinos ; bark of P. verticillatus. Black alder.
Pyrola; leaves of P. rotundifolia and other species.
Quercus alba ; the bark. White oak bark.
Quercus glandes; the fruit of various species of Quercus. Acorns.
Quercus tinctoria ; the bark. Black oak bark.
Rhus; bark and leaves of R. glabrum and other species. Sumach.
Rose Gallica ; the petals. Red rose.
Rubus ; root of R. villosus and Canadensis. Blackberry root.
Salix ; bark of S. alba and other species. Willow bark.
Salvia ; leaves of S. officinalis. Sage.
Santalum ; wood of Pterocarpus santalinus. Red saunders.
Spiræa ; root of Spiræa tomentosa. Hardhack.
Statice ; the root of S. Caroliniana. Marsh rosemary.
Tormentilla ; the root of Potentilla T. Tormentil.
Uva ursi ; leaves of Arctostaphylos U. U. Bearberry leaves.

Syllabus of Astringent and Allied Acids.

Gallotannic acid, $C_{27}H_{22}O_{17}$. Acidum tannicum.	In galls from Quercus infectoria, and Chinese galls from Distylium racemosum, and in sumach.
Gallic acid, $H_3C_7H_3O_5H_2O$.	In uva ursi, sumach, etc., the seeds of mangoes (Mangifera Indica) contain 7 per cent.
Pyrogallic acid, $HO,C_6H_5O_2$.	By destructive distillation of the former.
Paraellagic or rufigallic, $C_7H_4O_4+H_2O$.	By treating gallic acid with H_2SO_4, and throwing into water; precipitate sublimes in vermilion red prisms; little soluble in alcohol and ether.
Ellagic or bezoaric, $C_{14}H_6O_8+2H_2O$.	In oriental bezoars (animal calculi) and by decomposition of tannin; deposited by infusion of galls; yellowish, crystalline; inodorous; tasteless; insoluble in ether, nearly insoluble in water and alcohol.
Tannoxylic, $C_7H_6O_6$.	By KO and tannin at ordinary temperature; lead salt brick-red.
Tannomelanic, $C_6H_4O_3$.	By KO and tannin at 212°; lead salt dark brown.
Metagallic or galhuminic, $C_6H_4O_2$.	By heating gallic or tannic acid to 480°; black, tasteless, insoluble in water, soluble in KO.
Quercotannic (?).	In oak-bark, black tea, etc.; similar to gallotannic, but yields no gallic or pyrogallic acid.
Catechutannic or mimotannic (?).	In catechu, probably by oxidation of catechuic acid; light yellow; precipitates gelatine; protosalts of iron grayish-green, sesquisalts brownish-green; tartar emetic is not precipitated; yields no sugar with H_2SO_4.

* Juglans, *U. S. P.* The inner bark of Juglans cinerea is cathartic.

Catechuic or Tanningic (Catechin), $C_{19}H_{18}O_8$.	In catechu; white scales or needles; readily soluble in alcohol, boiling ether, and hot water; not precipitated by starch, gelatine, tartar emetic, or vegetable alkalies; by acetate of lead white, by sesquichloride of iron dark-green; by oxidation catechutannin is formed. (See *American Journal of Pharmacy*, xxviii. 326.)
Rufocatechuic or rubinic.	In the oxidized alkaline solution of the former. The tannin in *krameria* yields a similar red acid by spontaneous oxidation.
Catechuinic or Japonic, $C_6H_4O_2$.	Product of decomposition by KO; black.
Pyrocatechuic or oxyphenic or Pyrodioric, $C_6H_6O_2$.	By dry distillation of catechu, kino, rhatany, fustic, etc.; is carbolic acid + 2O; white crystals fusible at 234°; freely soluble in alcohol, ether, and water; reduces oxides of the noble metals; salts of Fe_2O_3 colored green; turning red by NH_3.
Kino or coccotannic.	In kino; readily soluble in alcohol and hot water, scarcely in ether; precipitates sesquisalts of iron, but not tartar emetic; by oxidation red.
Coffeotannic or chlorogenic, $C_{15}H_{18}O_8$.	In coffee, cahinca root, the leaves of Ilex Paraguayensis; colorless needles (?); sesquisalts of iron are colored green; protosalts, tartar emetic, and gelatine not precipitated; yields kinone with H_2SO_4 and MnO_2 (?).
Viridinic or coffeic, $C_7H_7O_4$.	By oxidation of former, or in presence of alkalies; brownish amorphous; solution in H_2SO_3 carmine, precipitated blue by water; its solution green; the lead salt blue.
Boheatannic, $C_7H_6O_4$+Aq.	In tea, besides quercotannic acid; deliquescent; fuses at 212° to a red compound.
Kinovotannic, $C_7H_9O_4$.	In Quina nova bark, not precipitated by gelatine, by Fe_2Cl_3 dark green; yields, by dry distillation, pyrocatechuic acid.
Rufikinovic (kinovic red).	By oxidation of former.
Cinchotannic, $C_{17}H_{16}O_9$.	Precipitated by sesquisalts of iron green, by tartar emetic, starch, gelatine, and albumen; soluble in diluted acids, alcohol, ether, and water.
Ruficinchonic (Cinchona Red).	In red cinchona; product of oxidation of the former; various ingredients of bark have received this name; that of H. Hasiwetz is of a chocolate or black color, soluble in alcohol, ether, and alkalies.
Moritannic, $C_{13}H_{10}O_6$+H_2O.	In fustic, Morus tinctoria; yellow prisms fusible at 400°; precipitated by gelatine; by tersulphate of iron greenish-black; by sugar of lead yellow, and partly by tartar emetic; with BO_3 a gelatinous mass; solution in alkalies turns dark brown.
Rufimoric, $C_8H_6O_4$+H_2O.	Brick-red floccules, with alkalies carmine-red solution, with alum, baryta, and tin, dark-red lakes; probably identical with carmic acid.
Moric (Morin), $C_{12}H_8O_5$.	In fustic; white, crystalline, with alkalies yellow, with Fe_2Cl_3 garnet-red; olive-green precipitate with salts of FeO.
Quercitritannic (?).	In quercitron bark; green with salts of Fe_2O_3; quercitric acid is probably nearly allied to it.
Galitannic, $C_7H_8O_5$.	In Galium verum and aparine; precipitates Fe_2Cl_3 dark-green; sugar of lead chrome yellow; by alkalies brown.
Aspertannic, $C_7H_8O_4$.	In Asperula odorata; readily soluble in water and alcohol, little in ether; colors Fe_2Cl_3 dark-green; not precipitated by albumen, gelatine, or tartar emetic.
Callutannic, $C_7H_8O_4$.	In Calluna vulgaris; precipitates Fe_2Cl_3 green, salts of PbO yellow, $SnCl_2$ yelk-yellow; heated with acids yields *calluxanthin*.
Rhodotannic, $C_7H_6O_3$+H_2O.	In the leaves of Rhododendron ferrugineum; amber yellow; precipitates salts of PbO chrome yellow; with acids *rhodoxanthin*.
Leditannic, $C_7H_6O_3$+3H_2O.	In Ledum palustre; reddish; readily soluble in water and alcohol; colors Fe_2Cl_3 green; with acids *ledixanthin*.

Rubichloric, $C_{14}H_{16}O_9$.	In Rubia tinctorum and asperula odorata; colorless; soluble in alcohol and water, insoluble in ether; by HCl yields *Chlorrubine*, $C_{12}H_4O_3$, a dark-green powder; soluble in alkalies, blood-red.
Cephaëlic, Ipecacuanhic, $C_7H_8O_3+H_2O$.	Very bitter; reddish-brown; soluble in water, alcohol, and ether; colors Fe_2Cl_3 green, on addition of NH_3 violet or black; precipitates salts of PbO white.
Pinitannic, $C_7H_8O_4$.	In the leaves of Pinus silvestris and Thuja occidentalis; yellow; soluble in water, alcohol, and ether; no precipitate with gelatine or tartar emetic; colors Fe_2Cl_3 red-brown; precipitates PbO yellow.
Oxypinitannic, $C_{14}H_{16}O_9$.	With the former; brownish; very soluble in alcohol and water; colors Fe_2Cl_3 intensely green; precipitates PbO and BaO yellow; not gelatine or tartar emetic.
Pinicortannic, $C_{16}H_{18}O_{11}$.	In the bark of Pinus silvestris; reddish-brown; colors Fe_2Cl_3 dark-green.
Cortepinitannic, $C_{16}H_4O_7$.	With the former; red; colors Fe_2Cl_3 intensely green.
Cissotannic, $C_{10}H_{12}O_8$.	The red coloring matter of autumnal leaves; very weak acid.
Xanthotannic, $C_{14}H_{18}O_2$.	The yellow coloring matter of autumnal leaves · weak acid, not precipitated by gelatine.

Acidum Tannicum. $\overline{\text{Tan}} = C_{27}H_{22}O_{17}$. (*Gallotannic Acid.*)

The new officinal process of the *Pharmacopœia* directs the maceration of powdered nutgall, previously exposed to a damp atmosphere for twenty-four hours, in ether, previously washed with water, sufficient to form a soft paste. This is to be set aside, closely covered, for six hours, then enveloped in a close canvas cloth, expressed powerfully between tinned plates to obtain the liquid portion. The remaining mass is to be again reduced to powder and mixed with sufficient ether, shaken with one-sixteenth its bulk of water to form again a soft paste, then expressed as before. The liquids being mixed are to be spontaneously evaporated to a syrupy consistence, then spread on glass or tinned plates and dried in a drying closet.

Gallotannic acid is also conveniently prepared by the former process, which consists of treating powdered galls in a narrow covered displacer, with washed ether. The ethereal tincture which passes separates, upon standing, into two layers; the lower one is aqueous, thick, and of a light buff or straw color; it contains the tannic acid, which, by the action of the small portion of water in the washed ether, has been dissolved out from the galls. The upper layer or stratum of liquor is limpid and specifically much lighter than the other; it has a greenish color, and contains very little tannin, but a small amount of coloring matter from the galls. To obtain the dry product, the light layer may be poured off and purified by distillation, and combined with water for another operation, while the thick heavier layer is evaporated in a capsule by a carefully regulated heat till dry.

If a white and very porous product is desired, the capsule should be inverted towards the end of the evaporation, and the thick syrupy liquid exposed to radiated heat. It is swelled up and whitened as the vapor is disengaged. The whole of the liquid which comes through may be evaporated without the precaution of

pouring off the top layer, but the tannin then has a greener tinge. In large manufacturing establishments, apparatus is, of course, constructed for saving all the ether for future use. The first process, as above, though perhaps less eligible for the use of the pharmacist in making the acid on a small scale, corresponds more nearly with that in common use by manufacturing chemists. The results are nearly the same by both processes, the yield varying from 30 to 60 per cent. of the galls employed

Gallotannic acid is a yellowish-white powder, or in a porous pulverulent condition; has a strongly astringent taste; is entirely dissipated when thrown on red-hot iron. It is freely soluble in water, alcohol, glycerin, in ether, in the fixed and volatile oils. Its aqueous solution reddens litmus and produces with solution of gelatin a white flocculent precipitate, with salts of sesquioxide of iron a bluish-black precipitate, and with solutions of the organic alkalies white precipitates, very soluble in acetic acid.

Mohr, Sandrock, and others assert the syrupy liquid (the lower layer as above) to be a concentrated solution of tannin in ether, which is not miscible with ether, except by the intervention of a little alcohol; they therefore reject the employment of aqueous ether, which has a tendency to swell up the powdered galls, and retard percolation, and recommend a mixture of 90 per cent. alcohol and ether (one to twenty parts, Guibourt).

The concentrated ethereal solution containing 46.5 to 56.2 per cent. of tannic acid (Mohr), and being insoluble in ether, it was suggested in the second edition, might be a tannic ether; 13 equivalents of ether = 481 to 1 equivalent of tannin = 618, require exactly 56.2 per cent. of the latter and 43.8 per cent. of the former. Prof. J. M. Maisch was the first to observe this, and Prof. Bolley has since published a similar observation; other chemists still adhere to the older view of the solubility of tannin in ether. (See *Amer. Journ. Pharm.*, 1861, 207, 219, 337, and *Proc. Amer. Ph. Assoc.*, 1862, 158.)

Acidum Gallicum. $\overline{Ga} = 3HO,C_7H_6O_5$. (*Gallic Acid.*)

Gallic acid is made by subjecting a portion of powdered galls to long-continued action of air and moisture in a warm place. This may be accomplished in an evaporating capsule loosely covered with paper. The powder is first made into a thin paste with water, and water repeatedly added to this to prevent its drying, until after the lapse of thirty days (*U. S. P.*), when the whole of the tannic has passed spontaneously into gallic acid. In extracting this from the moist mass, advantage is taken of the solubility of gallic acid in hot water, and its ready precipitation on cooling; all that is necessary is to press out from the pasty mass its water, and, rejecting this, to digest the remaining paste in hot water, and filter the solution while hot through animal charcoal to decolorize it, and a nearly white crystalline powder of gallic acid is obtained. A water-bath funnel, Fig. 142, is used for filtering the solution while hot. Care must be taken in these processes not to employ vessels of tinned

iron, which, by the exposure of a small surface of iron, may blacken the whole product. The amount of gallic acid obtained from galls is about 20 per cent.

The ferment inducing the change of tannic into gallic acid is identical with pectase; emulsin, yeast, albumen, and legumin are without action, on the contrary they retard the influence of pectase. Tannin, according to Strecker, is decomposed into 3 equivalents of gallic acid and one of grape sugar; $C_{27}H_{22}O_{17} + 4H_2O = 3H_3C_7H_3O_5 + C_6H_{12}O_6$; but Knop obtained from gallotannin 94 per cent. gallic acid, and Kawalier regards it as a mixture of two compounds, one of which yields gallic, and the other, present only in small proportion, yields ellagic acid.

The same decomposition of tannic acid is induced by the influence of diluted sulphuric acid, and the process for obtaining gallic acid can be materially shortened if, instead of exposure to the atmosphere, galls or tannin are treated with dilute sulphuric acid at the boiling point. Otherwise the process remains the same as above given.

Gallic acid is soluble in cold water in about the proportion of 4 grains to the ounce. Its salts with the alkalies and alkaline earths are crystallizable; at a boiling temperature, sesquisalts of iron are decomposed by being reduced to protosalts, carbonic acid being given off at the same time.

In common with tannin, it is usually given in pills, and used externally in ointments or solution. It is likewise used in hair dyes, an ammoniacal solution of nitrate of silver being afterwards employed to produce the color.

Pyrogallic Acid.—$C_6H_6O_3$ = gallic acid $C_7H_6O_5 - CO_2$.—The best and cheapest method for preparing it is from the dry aqueous extract of galls in an apparatus suited to subliming benzoic acid, heated in a bath of sand or chloride of zinc, to 400° F., and towards the end of the process a little higher. 100 parts of dry extract yield about 5 parts perfectly pure pyrogallic acid, and the same amount of impure, to be purified by another sublimation. By dry distillation of Chinese galls in small retorts, Liebig obtained a liquid, yielding, on evaporation, 15 per cent. brown crystallized pyrogallic acid.

White laminæ or needles of a pearly lustre, soluble in $2\frac{1}{2}$ parts water at 55° F., less in alcohol and ether; the solutions do not affect litmus paper; its taste is very bitter; fusible at 240° F., boiling at about 400°, at 480° it is blackened and converted into metagallic acid. Solution of pyrogallic acid, if dropped into milk of lime, produces a characteristic red coloration, changing to brown. Protosulphate of iron produces a bluish-black color, a trace of sesquisalt changes it to a dark green. Sesquisalts of iron color a solution of the acid red; hydrated sesquioxide of iron and a pyrogallate give a dark blue liquid and precipitate.

It is much employed in photography on account of its great sensitiveness to light in combination with silver, and for dyeing the hair brown and black. The salts are more soluble than the gallates.

Seventh Group.—Acids of Animal Origin.

Two acids have been described in the second group, which for a long time were supposed to be exclusively of animal origin, though likewise formed by the decomposition of certain organic compounds of vegetable products; modern chemistry, however, has established the fact that formic and lactic acids are both produced during the natural healthful life of some vegetable organisms, and that the nettles, for instance, owe their powerful irritant effect to the same acid that nature has provided for the defence of ants, wasps, and bees.

Vegetable acids, to the exclusion of but a few compounds which from their chemical behavior may be classed with the acids, are destitute of nitrogen; the acids arranged in this group all contain nitrogen, one also sulphur, and are produced by the functions of some of the most important organs of the animal economy; they comprise the acids found in the muscles, occurring in the urine, and being the active constituents of bile. None of them have been used in medicine in a free state; the impure soda salt of one of the biliary acids, however, has been somewhat employed as a substitute for inspissated bile, and others may probably be found useful if attention is drawn to them.

Syllabus of Animal Acids.

Inosinic acid, $C_{10}H_{14}N_2O_{11}$.	In the juice of the meat of most animals and ingredient of culinary and dietetic preparations of meat; strong acid, agreeable taste of broth, decomposed by boiling; precipitated by alcohol in crystalline floccules; insoluble in ether.
Uric or Lithic acid, $C_5N_4H_4O_3$.	Free and combined in the urine of birds, reptiles, some molluscs and insects; in the urinary sediment and calculi of man and quadrupeds; white silky scales or needles; soluble in 14,000 parts cold and 1800 parts boiling water, insoluble in alcohol and ether. Evaporated with diluted HNO_3, and NH_4 added, forms *murexide*. Salts mostly insoluble or sparingly soluble.
Hippuric acid, $C_9H_9NO_3$.	In the urine of man and herbivorous animals, increased by partaking of benzyle (tolyle) compounds. Colorless prisms or needles; taste bitterish acid; soluble in alcohol, in 400 parts cold water, less in ether. Salts mostly soluble in boiling alcohol and boiling water; the alkaline salts soluble in the cold.
Cholic or glycocholic acid, $C_{24}H_{40}O_5$.	As soda salt in the bile of most animals. Thin white needles; taste sweetish and bitter; very easily soluble in alcohol, less in ether, with difficulty in water; salts soluble in alcohol.
Hyocholic acid, $C_{25}H_{40}O_4$.	Combined with soda, potassa, and ammonia in the bile of the hog. Colorless, amorphous, fuses in boiling water; little soluble in water, readily in alcohol, insoluble in ether; alkaline salts soluble in alcohol and water, not in ether, separated from its solutions by NaCl.
Sulphocholic, Taurocholic, or choleinic acid, $C_{26}H_{45}NSO_7$.	In small quantity in the bile of the ox and other animals. Resinous, soluble in little water, turbid by more; solution dissolves fats, fatty acids, and cholesterin. Alkaline salts, soluble in alcohol and water, crystallize in contact with ether.

Inosinic Acid.—The mother-liquor of the preparation of creatine is precipitated by alcohol, the crystals in hot solution are decomposed by chloride of barium; the crystallizing inosinate of baryta decomposed by sulphuric acid, and the concentrated solution of inosinic acid precipitated by alcohol.

Uric acid is readily prepared from guano, by exhausting it first with water, then treating with potassa, precipitating by chloride of calcium, and the filtrate by muriatic acid; the precipitated acid is to be purified.

The quantity of uric acid in urine is determined by precipitating this liquid with an acid; if no albumen is present, muriatic acid will answer, otherwise acetic, or, better, phosphoric acid is to be used; the liquid retains of uric acid only .009 per cent. of its weight, which loss is usually made up by the precipitation of coloring matter.

Gregory's process for obtaining it is as follows: the fresh urine of cows or horses is mixed with milk of lime in excess, boiled, strained, and evaporated to $\frac{1}{8}$ its original measure; it is then supersaturated with muriatic acid, and the crystallized acid purified by again combining it with lime and decomposing with muriatic acid.

The urine of cows contains 1.3, of horses .38 per cent. of hippuric acid; in putrefied urine it is changed to benzoic acid. Boiled with dilute acids or alkalies, it splits into benzoic acid, $C_7H_6O_2$, and glycocoll, $C_2H_5NO_2$.

Glycocoll, glycin, or amido-acetic acid, $C_2H_5NO_2$, is formed by the action of sulphuric acid or potassa upon gelatine, and is found in hippuric and the nitrogenated biliary acids. It occurs in colorless hard crystals, soluble in 4.3 p. cold water and in boiling diluted alcohol, has a faint acid reaction, no odor, and a sweet saccharine taste; heated with a concentrated alkali, it assumes a bright fire-red color and decomposes.

Bile is separated by the liver; it is a liquid containing about 90 per cent. water, has a strongly bitter taste and a yellowish or brownish-green color, and a neutral or faint alkaline reaction. Its consistence is due to mucus, its coloring matters produce iridescence with nitric acid and its acids, and their acid derivatives yield a purple coloration with sugar and sulphuric acid. We owe most of our present knowledge of the constituents of bile to the researches of Prof. Strecker.

The biliary acids are best prepared by precipitating fresh bile with acetate of lead, washing the precipitate with hot alcohol, and decomposing the residue by sulphuretted hydrogen; *cholic acid* is thus obtained. *Taurocholic acid* is precipitated by subacetate of lead from the mother-liquor filtered from the above precipitate by sugar of lead. *Hyocholic acid* is with less trouble obtained by separating its soda salt with table salt, purifying by alcohol, and decomposing by sulphuric acid.

Impure *cholate of soda, bilin* of Berzelius, has been proposed as a substitute for ox-gall in doses varying from 5 to 15 grains three

or four times daily. It is easily prepared by evaporating fresh ox-gall to one-half, precipitating slimy and coloring matter by alcohol, treating the filtrate with animal charcoal, evaporating and washing with ether.

The acids are copulated compounds, and split on treatment with boiling dilute acids or alkalies into their constituents as follows:—

Cholic acid.	$C_{24}H_{40}O_5 + H_2O =$ Cholalic acid + Glycocoll.
Hyocholic acid,	$C_{25}H_{40}O_4 + H_2O =$ Hyocholalic acid + Glycocoll.
Taurocholic "	$C_{26}H_{45}NSO_7 + H_2O =$ Cholalic " + Taurin.

Taurin or *bilasparagin*, $C_2H_7NSO_3$, crystallizes in large colorless prisms of a cooling taste; soluble in 16 p. cold water, little in alcohol; it is one of the most stable compounds, not being decomposed by concentrated sulphuric and nitric acids.

When the biliary acids are oxidized by nitric acid, one of the products is *cholesteric* acid, $C_8H_{10}O_5$, which is likewise obtained by the same process from

Cholesterin, $C_{26}H_{43}H_2O$, which is met with frequently in the body of the higher animals and man, in bile, particularly in the biliary stones, in the nerves, brain, blood, yelk, pus, and other morbid excretions. It forms white shining scales, is inodorous and tasteless; insoluble in water, dilute acids and alkalies, but soluble in alcohol, ether, and solutions of soap and the biliary acids. To detect it when present in small proportions, and particularly when associated with fats, is not without difficulty; in the latter case the formation of a lead soap and its exhaustion by ether or boiling alcohol are advisable.

Eighth Group.—Acids pertaining to Coloring Matters.

The organic coloring matters are chemical compounds, the character of which is not clearly ascertained, except in a few instances. All those substances which in their dry state or in solution are remarkable for decided coloration, may be called coloring principles; sanguinarina and hydrastia have been thus classified; they are, however, alkaloids, and will be treated of in their proper place. Of the coloring matters in the following lists, many of those placed in division *a* have acid properties so decided as to expel carbonic acid; the acid properties of others are not so easily recognized, as they frequently dissolve in acids and alkalies with different colors, and in such solutions are readily affected by atmospheric oxygen, particularly at high temperatures. But as far as the latter property is concerned, they are not the only acids changed in this way; the whole group of tannins and their derivatives are equally unstable, and probably even more so, than many coloring acids.

Most of those which follow are precipitated by acetate or subacetate of lead, and may be obtained in a free state by decomposing such precipitates, diffused in alcohol, by sulphuric acid or sulphuretted hydrogen. Compounds may be formed with alumina, if their mixture with a solution of alum is precipitated by ammonia; such colored precipitates are called *lakes*.

(a) *Acids from Phanerogamic Plants.*

Carthamic acid, $C_{14}H_{16}O_7$, *carthamin.* — In Carthamus tinctorius; amorphous; carmine red, with a green metallic lustre; little soluble in water; soluble in alcohol.

Carthaxanthic acid, $C_{24}H_{30}O_{15}$. — Yellow extract; soluble in water; brown in contact with air.

Crocic acid, $C_{48}H_{43}O_{31}$, *polychroite.* — In saffron, and in the fruit of Gardenia grandiflora; brilliantly red; by HNO_3 green, by H_2SO_4 indigo-blue (tests for saffron); soluble in water, more in alkalies, by hot diluted acids split into *crocetin*, $C_{24}H_{23}O_{11}$, and sugar.

Rottleric acid, $C_{11}H_{10}O_3$, *rottlerin.* — In the hairy covering of the fruit of Rottlera tinctoria; brilliant yellow crystals; red by alkalies.

Chrysophanic acid, $C_{10}H_8O_3$. — In senna, rhubarb, etc.; boracic acid does not turn it brown. (*See also* Rhamnin.)

Xanthorhamnic acid, $C_{23}H_{28}O_{14}$. — In the fruit of Rhamnus tinctoria; crystalline; readily soluble in water and hot alcohol; insoluble in ether; by boiling with dilute acids yields *rhamnetin*, $C_{22}H_{10}O_{10}$, and sugar. (*See* Quercitric Acid.)

Rhamnoxanthic acid, $C_{12}H_{12}O_6$, *frangulin.* — In the root and bark of Rhamnus frangula; lemon-yellow crystalline powder; insoluble in water and ether; soluble in 160 p. hot alcohol; in H_2SO_4 with a ruby, in alkalies with a purple color.

Loao or *Chinese green* is the Al_2O_3 compound of Rhamnus chlorophorus and utilis.

Sap green is prepared from the unripe berries of Rhamnus cathartica.

Gentisic acid, $C_{28}H_{10}O_{10}$. — In gentian root. Yellow needles; not bitter; soluble in alcohol.

Santalic acid, $C_{15}H_{14}O_5$, *santalin.* — In red saunders, Santalum rubrum; microscopic red crystals; nearly insoluble in water; purple by alkalies.

Ruberythric acid, $C_{36}H_{40}O_{20}$. — In madder, the root of Rubia tinctorum; yellow prisms; soluble in hot water, alcohol, and ether; with Al_2O_3 a bright red lake; is a glucoside; yields *Alizarin*, *lizaric acid*, $C_{20}H_6O_6$. Sublimed in orange-colored prisms; from solutions, in brownish-yellow prisms with $4H_2O$; with alkalies purple, with lime and baryta blue.

Oxylizaric acid, $C_9H_6O_3 + H_2O$, *purpurin.* — From madder by fermentation; red or orange needles; with alkalies cherry-red, with lime and baryta purple precipitates.

Anchusic acid, $C_{35}H_{40}O_8$. — In anchusa, alkanet root. Deep red; insoluble in water; the salts purple or blue, bleached by light.

Brazilic acid, $C_{36}H_{14}O_{14}$, *brazilin.* — In Brazil wood. Yellowish-red prisms; soluble in alcohol, ether, and water; by alkalies purple.

Bixic acid (?). — In annatto from Bixa orellana; red, resinous; soluble reddish-yellow in alkalies; indigo-blue in H_2SO_4.

Carotic (?), $C_{18}H_{24}O$, *Carotin.* — Copper-red, microscopic crystals; no odor or taste; insoluble in water and ether, slightly in alcohol; soluble in fixed and essential oils; blue by H_2SO_4 and SO_3.

Quercitric, or *Rutinic acid*, $C_{70}H_{36}O_{40}$. — In quercitron bark, Ruta graveolens, Capparis, Æsculus, Fagopyrum, and Humulus; crystalline, chrome-yellow, bitterish; soluble in alcohol and alkalies, less in water, little in ether; as found in the different plants, it is quercetin with various proportions of the carbohydrate, $C_{12}H_{15}O_{15}$.

Quercetin, $C_{27}H_{18}O_{12}$. — Crystalline, yellow; by Fe_2Cl_3 green; probably identical with rhamnetin and the following.

Luteolic acid, $C_{20}H_{14}O_3$ (?) *luteolin.* — In French weld from Reseda luteola. Yellow needles by sublimation; nearly insoluble in water.

Thujic acid, $C_{20}H_{22}O_{12}$, *thujin.* — In Thuja occidentalis; lemon-yellow, astringent; soluble in hot water and alcohol; green by Fe_2Cl_3; it splits into glucose and *thujetin*, $C_{28}H_{14}O_{16}$; its alcoholic solution by Fe_2Cl_3 inky, by alkalies green.

Mangostic acid, $C_{40}H_{22}O_{10}$, *Mangostin.* — In the rind of Garcinia Mangostana, golden-yellow scales; tasteless; insoluble in water, soluble in alcohol, ether, and alkalies; by HNO_3 oxalic acid.

Gambogic acid, $C_{20}H_{23}O_4$. In gamboge, amorphous, yellow; soluble red in NH_3, and yellow in alcohol; precipitated by concentrated solutions of alkaline salts, but the precipitate soluble in pure water.

Pipizaic acid, $C_{30}H_{20}O_6$. In pipizateo root, a Mexican cathartic; readily soluble in absolute alcohol and ether; its alkaline salts purple and easily soluble in alcohol, ether, and water.

Scoparic acid, $C_{21}H_{22}O_{10}$, *scoparin*. In Spartium scoparium; light yellow crystals; tasteless, inodorous; soluble in alcohol; easily in alkalies and concentrated acids; by CaCl dark-green; precipitates by PbO salts.

Ilixanthic acid, $C_{17}H_{22}O_{11}$. In the leaves of Ilex aquifolium; straw-yellow needles; soluble in hot water and alcohol, insoluble in ether; with PbO yellow lakes.

Hæmatoxylic acid, $C_{16}H_{14}O_6$, *hæmatoxylin*. In logwood, from Hæmatoxylon Campechianum. Yellow prisms; taste of liquorice; little soluble in water; by moisture and alkalies converted into *Hæmatein*, $C_{32}H_{10}O_{10}$; dark-green, metallic lustre; with bases red, violet, or blue.

Curcumic acid (?), *curcumin*. In turmeric, Curcuma longa; yellow crystals; slightly soluble in water; soluble in alcohol and ether, very soluble in benzol; does not sublime; begins to melt at 165° C.; solutions are very fluorescent; brown with alkalies.

(b) *Acids from Cryptogamic Plants.*

The natural chromogenic acids form various species of the genera Lichen, Variolaria, Lecanora, Rosella, Gyrophora, etc., are copulated compounds, colorless, or but slightly colored, and yield by boiling with water, alcohol, or alkalies, *orsellic acid*, $C_8H_8O_4$ and another acid or neutral compound which is usually likewise copulated. The former is, by continuing the process, converted into *orcine*, $C_7H_8O_2$, which by ammonia, moisture, and oxygen yields the coloring matter *orceine*, $C_7C_7N.O_3$ (orceic acid), which, with ammonia, furnishes a deep red, with alkalies a violet or purple solution; this is the coloring principle of *cudbear* and *archil*.

Erythric acid, $C_{20}H_{22}O_{10}$. From Roccella tinctoria; yields $C_{16}H_8O_8$, and erythrin, $C_{26}H_{22}O_{10}$, which again yields $C_{16}H_8O_8$, besides Erythromannite.

Alphaorsellic acid, $C_8H_8O_4$. From a variety of the same.

Betaorsellic acid, $C_8H_{10}O_2$. From another variety.

Evernic acid, $C_{17}H_{16}O_7$. From Evernia prunastri.

Gyrophoric acid, $C_{36}H_{18}O_{15}$. From Gyrophora pustulata; intermediate product unknown.

Litmus is obtained from Lecanora tartarica and some other lichens by a different process; its coloring principles are probably derivatives of orcine, or, as Kane believes, of roccellin. The following have been distinguished; all are amorphous and little soluble in water, and yield lakes of blue or purple color; the formulas are those of Kane.

Azolitmin, $C_9H_{10}NO_5$; deep brown-red, soluble in alkalies with blue color.

Spaniolitmin, light red, insoluble in alcohol and ether, soluble in alkalies blue.

Erythrolitmin, $C_{26}H_{22}O_6$, light red, easily soluble in alcohol, not in ether. The hot solution deposits it in soft deep-red granules.

Erythrolein, $C_{18}H_{22}O_2$, semiliquid; easily soluble in alcohol and ether with dark-red color, in ammonia purple.

(c) *Azotized Vegetable Coloring Matters.*

There are but two of this division, which have not the least relation to each other; moreover, one is a complex body never obtained in a state of purity.

Indigogen, C_8H_6NO. In the juice of various plants yielding indigo.
Chlorophyl, $C_9H_9NO_4$. The green coloring matter of leaves and herbs.

Indigogen, or Indigo white, is contained in the juice of plants yielding indigo in a state of combination with alkalies; owing to its proneness to oxidation, it is difficult to be obtained in a state of purity. During the process of fermentation of the leaves, it is oxidized and converted into indigo blue, other matters being separated at the same time, the whole constituting commercial indigo.

The coloring principle upon which the value of indigo depends has been named

Indigotin, C_8H_5NO; amorphous, subliming in hexagonal prisms, deep blue with a tinge of purple, tasteless and inodorous; insoluble in nearly all solvents; yields by dry distillation anilina, NH_3,HCy, and empyreumatic oils.

Indigo has been used in epilepsy, taken internally; a portion is found in urine which deposits occasionally a blue pigment, *urocyanin*, which is at least frequently identical with indigotin. The blue coloring matter of some milk appears to be sometimes the same pigment, and may then be derived from plants containing indigogen.

If indigo is exhausted with sulphuric acid, the solution treated with concentrated solution of acetate of potassium, the precipitate washed with the same solution to remove KSO_4, and finally with alcohol to extract $K\overline{Ac}$, the residue is

Indigosulphate, Sulphocærulate of potassium, or *indigocarmine* in a pure state. Schnack calls the indigo-white *indican*, $C_{16}H_{33}NO_{18}$; it splits by cold acids into *indigo-blue*, C_8H_5NO, and *indiglucin*, $C_6H_{10}O_6$. Through various influences a number of different coloring matters contained in the commercial indigo and other compounds are formed; among the latter are carbonic, formic, acetic, and propionic acids.

Chlorophyll occurs in the green parts of plants in the form of globules or granules composed of a green membrane and semi-liquid matter, enveloping a starch granule (Böhm), or it is a transparent colorless membrane, containing a green liquid with some minute granules. It is always accompanied by protein and waxy matters, and the true coloring principle is present only in very minute quantity, which renders its separation very difficult. Its chemical relations are, therefore, still somewhat uncertain.

Fremy supposes it to consist of *phylloxanthin* and *phyllocyanin* which, being mixed in different proportions, furnish the different shades of green in leaves; the latter is wanting in the yellow autumnal foliage.

The yellow (*xanthophyll*) and red (*erythrophyll*) coloring matters of the leaves in autumn are products of decomposition of the chlo-

rophyll; Wittstein and Ferrein suppose both to be weak tannins. (*See* Cisso and Xanthotannic Acid.)

Xanthein and *cyanin* are said to be the yellow and blue principles furnishing all the innumerable shades of the yellow, blue, green, and red colors, which we admire in the petals of flowers; they are then in combination with one another, with various alkalies and acids. It has, however, been proved that the flowers of Reseda luteola, Capparis spinosa, and Aesculus hippocastanum contain quercitrin, and Hlasiwetz suggests that other than yellow colors may be due to the same glucoside or some derivative. (See *Am. Jour. Phar.*, 1860, 222.)

(d) *Ternary Animal Coloring Matters.*

Carmic acid, $C_{14}H_{14}O_8$.	In cochineal, and probably in the flowers of Monarda didyma, and identical with rufimaric acid, as by dry distillation oxyphenic acid is obtained; brownish-purple, friable, freely soluble in water and alcohol, sparingly in ether.
Euxanthic or Purreeic acid, $HC_{21}H_{17}HO_{11}$.	In purree, an East Indian pigment from the urine of camels after they have eaten the fruits of Mangostana mangifera; yellow shining prisms; soluble in boiling water, more in hot alcohol and ether; inodorous, bitter sweetish taste; salts yellow, crystalline, or gelatinous.

(e) *Azotized Animal Coloring Matters.*

Hæmatin or Hæmatosin, $C_{44}H_{44}N_6O_6Fe$.	In the blood of all vertebrate animals; brownish-red; inodorous and tasteless; insoluble in alcohol, water, and ether, soluble in acidulated alcohol, alkalies, and aqueous solutions of the salts in blood.
Urerythrin or Urohæmatin?	The coloring matter of human urine; dark-red; insoluble in water, acids, and many salts; soluble in alcohol, ether, chloroform, and warm fresh urine.
Bilifuscin, $C_{16}H_{20}N_2O_4$.	The brown coloring matter of bile and biliary concretions; dark brown with olive-green tinge; little soluble in water, more in alcohol and alkalies.

The preparation of these coloring matters is connected with many difficulties, and we have even no proof that they can be separated without decomposition; moreover it is likely that as soon as they are separated from the organism, they commence to undergo alterations under the influence of air and light. The latter two of the above syllabus are believed to be derivatives from the coloring matter of the blood.

Hæmatin occurs naturally together with globuline as hæmatoglobulin, and the detection of blood in physiological and forensic analysis is based partly on the presence of the latter, partly on the separation of the former, or one of its modifications, or the recognition of the iron. It has been proposed as a new remedy by Prof. Fabourn, of Lyons, supposed to assist the formation of blood-corpuscles, and to contain 10 per cent. of iron. Prepared by thickening the blood with an inactive salt, subjecting the resulting magma to pressure, extracting the press-cake with alcohol containing 2 or 3 per cent of an acid. On neutralizing this the hæmatosin separates in reddish flocks, which are to be washed successively with

water, alcohol, and ether, and on drying may be taken in powder or pill.

Hæmatoidine occurs in stagnant blood, in the form of red or yellowish-red crystals or is amorphous, and is insoluble in water, alcohol, ether, alkalies, and acids.

Hæmin may be prepared from a minute quantity of old or fresh blood, by dissolving it in glacial acetic acid, boiling it for a moment, and evaporating a few drops upon glass. It forms red or brown crystals, and is insoluble in water, alcohol, ether, and chloroform, but soluble in potassa. The formation of these microscopic crystals forms now one of the principal tests for recognizing blood.

Heller recognizes blood in urine by boiling it, when the coagulated albumen will contain all the hæmatin. If to the boiling urine some potassa is added, the albumen is dissolved, a bottle-green color is produced, and the earthy phosphates settle with a brownish or blood-red color, showing a dichroism in green.

Pathological liquids are mixed with some normal urine, and blood spots are previously dissolved in water, in alcohol acidulated with H_2SO_4, or in a solution of sulphate of sodium, when they are treated as before.

Blood, if corpuscles cannot be recognized, shows its presence by the odor of burning feathers when heated to near redness, and by the production of Prussian blue when heated with some sodium, and precipitating the solution by a salt of Fe_2O_3+FeO. (See papers on the subject in *Am. Journ. Pharm.*, 1857, 30; 1861, 439; 1862, 331; and *Am. Drugg. Circular*, 1860, 260.)

The brown and yellow *biliary coloring matters* are recognized in the alcoholic alkaline solution, which turns green on the addition of HCl, and blue by the addition guttatim of HNO_3. The most reliable test is the change of color which is produced by HNO_3 containing HNO_2; the color passes then through green, blue, violet, red into yellow

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CHAPTER VIII.

ON THE ORGANIC ALKALIES OR ALKALOIDS.

The whole science of organic chemistry is comparatively new, the discovery of the existence of the vegetable alkalies, the most important class of organic principles, dating back only to 1817, when Serturner, a German apothecary, announced the existence of morphia.

The study of all classes of organic bodies has since progressed rapidly, many discoveries have been announced, which have been subjected to revision and been superseded by others, and this process is still going on; all that the pharmacologist can expect to do is to present the actual state of knowledge upon the several sub-

jects under examination, awaiting the progress of analytical and synthetical investigation to confirm existing views, or to present others more in accordance with the requirements of exact science.

In the present uncertain state of chemical knowledge in regard to the alkaloids, we shall follow the classification indicated by nature in her morphological developments, and arrange the natural alkaloids as the other classes of organic chemical principles upon a botanical basis; those of animal origin and those produced by artificial processes being grouped separately.

The alkaloids, as a class, are the most powerful of organic principles, displaying their effects especially on the nervous system, which they so forcibly impress as to constitute many of them virulent poisons; a few, however, seem nearly destitute of active properties. They all contain nitrogen, and, by destructive distillation, or by heating with alkalies, evolve ammonia; most of them evince their alkalinity by restoring the blue color to reddened litmus, and though not always crystalline or even solid, they combine with acids to form definite salts which are crystalline; they also, like the alkalies proper, form double salts with bichloride of platinum.

Most of the alkaloids are sparingly soluble in water, but dissolve freely in alcohol, especially with heat; some dissolve in ether, fixed and essential oils, and almost all in benzine, bisulphuret of carbon, amylic alcohol, and chloroform, which may be used for their extraction. They are nearly all precipitated from solution, whether alone or combined as salts, by tannic acid, which is hence, when taken immediately, one of the best chemical antidotes for them, with the exception of those soluble in water; they are mostly precipitated by alkalies, in an excess of which many are redissolved.

The vegetable alkalies do not exist free in plants, but are generally combined with peculiar vegetable acids. Certain natural families of plants are distinguished by containing the same or similar alkaloids in their several species, while in other instances the same plant contains two or more different alkaloids. Opium contains nine, St. Ignatius's bean and nux vomica three, sabadilla and veratrum three, while the different species of cinchona are known to contain at least four.

It is believed that every really poisonous plant contains an alkaloid or neutral characteristic principle. It is remarkable that the development of the active principle is frequently only in one organ of the plant, and only at a certain period of its growth.

There is no convenient and scientific classification of the organic alkalies, and their composition which is known, at least empirically, affords no clue to their properties and relations; indeed, their separation from some of the class of peculiar neutral principles, though sanctioned by a well-known chemical distinction, seems forced and unnatural when we compare their physical and therapeutic properties, and is constantly overlooked by writers.

Considering the recent discovery of most of this class, it might be expected that a uniform system of nomenclature would obtain in regard to them. This, however, is only measurably the case; they

are most usually named from the generic title of the plants from which first derived, or from some distinguishing property; but by many they are indiscriminately terminated by *in* or *ia*. This practice is contrary to the rule adopted by common consent in this country, appropriating to the neutral principles the former, and to the organic alkalies the latter, termination. Even the officinal alkaloids are constantly misnamed from a disregard to this rule. In converting the foreign names into our own Latinized form, some discrepancies arise, as aconitina and aconitia, applied to the same substance.

The symbols used in some works to designate this class of principles are omitted in this as interfering with the convenience of its mechanical execution. In these symbols the first letters of the respective names are surmounted by a + sign, to designate the organic alkali, as in the case of acids the — sign is employed. A sufficient advantage does not seem to be secured by the use of this abbreviated method to compensate for its increased complexity and the liability to mistakes on the part of the student.

The mode of preparation of the organic alkalies varies with their habitudes, and particularly according to their solubility and that of their native combinations. When the native salt is soluble in water, as meconate of morphia, and the organic alkali is itself insoluble, there is no difficulty in its extraction, the simple addition of a strong alkali to the infusion of the vegetable substance neutralizes the organic acid with which the alkaloid was associated, and it is thrown down in a more or less pure form. It more frequently happens that the native alkaloid salt is not so freely soluble in water, and then a diluted acid is employed for its extraction; so that its salt with an inorganic acid is obtained, and, this being decomposed by an alkali, yields the pure precipitated alkaloid. In a large number of cases, however, these simple methods of extraction are quite useless, and complex processes are necessarily resorted to. Some of these are founded upon the alkaloid being separated from its associated principles by subacetate of lead. Some processes direct ether, benzine, or chloroform as the solvent, which separates the alkaloids from the other proximate principles present, and deposits them upon evaporation. The volatile alkaloids are, of course, prepared by appropriate modifications of the process of distillation.

The use of animal charcoal for its powerful absorbent properties, and the subsequent extraction of the alkaloid by appropriate solvents, is a process sometimes resorted to with success.

It is not intended to go into detail on these processes except in a few cases, as many of the alkaloids are seldom called for, and those in use are prepared almost exclusively on a large scale by chemical manufacturers.

Chemical History.—The study of the native organic alkalies has not as yet revealed their actual composition, the empirical formulas only being ascertained by our present means of analysis. From their behavior to tests we know that they have a certain relation to ammonia, and it is by the study of the artificial alkaloids that

we are able to form an idea of the real chemical nature of the whole class.

By the destructive distillation of many nitrogenated substances, compounds are obtained containing nitrogen, and having the behavior of alkaloids; they are closely allied to ammonia. This base, though generally classed among the inorganic compounds, is, in fact, merely the last stage of decomposition of organic nitrogenated bodies, containing only two elements, nitrogen and hydrogen. Like it, the compounds referred to have strong alkaline properties, in some instances even stronger than ammonia, and, as already stated, like the strong inorganic alkalies, readily form crystallizable double salts with bichloride of platinum.

The organic alkalies, chiefly on account of their strong affinity for acids, and of their property of evolving ammonia when heated with caustic potassa, have long been viewed by some chemists, especially Berzelius, as compounds of ammonia with other complex bodies; since the discovery of the artificial alkaloids, and the investigations into their constitution, this view has been somewhat modified so as to consider them as ammonia, in the composition of which one or more equivalents of hydrogen have been substituted by a radical; and since this view of their composition has gained ground, the number of the artificial alkaloids has been largely increased, and the probability has been shown of its further increasing to a surprising extent.

Among the inorganic compounds, even some metals are capable of replacing one or more equivalents of hydrogen in ammonia to form bases, as in the well-known instances of Cuprum ammoniatum and Hydrargyrum ammoniatum of the *Pharmacopœia;* it now remains to be shown how the elements are grouped in compounds of this nature, and which of the atomic elements or groups may be substituted for the hydrogen in ammonia to form alkaloids.

Such substituting compounds we find among the carbo-hydrogens, such as methyle CH_3, ethyle C_2H_5, propyle C_3H_7, butyle C_4H_9, amyle C_5H_{10}, capryle C_6H_{13}, phenyle (benzid) C_6H_5; oxygenated radicals like benzoyle C_7H_5O, cumyle $C_{10}H_{11}O$, etc.; the elements forming hydracids, bromine, iodine, chlorine, cyanogen; nitric peroxide NO_2, and a great variety of other elements and groups.

The newly-formed compounds have an alkaline character as long as they correspond in composition with ammonia. As a general rule, the compounds with the radicals of the hydracids have a weaker basic character, which becomes less decided as the number of equivalents of these radicals is increased in the alkaloid; with three equivalents of an element of the hydracid group, all alkalinity is lost; such compounds, however, do not correspond with ammonia or the oxide of ammonium in composition. The artificial alkaloids, after combining with acids, correspond closely in composition with the ammonia salts.

Series of Alkaloids containing Phenyle, C_6H_5, illustrating the foregoing.

Phenylamina (anilina)	C_6H_7N.
Methylanilina	C_7H_9N.
Ethylanilina	$C_8H_{11}N$.
Diethylanilina	$C_{10}H_{15}N$.
Methyl-ethylanilina	$C_{12}H_{13}N$.*
Chloranilina	$C_6H_4ClH_2N$.
Bichloranilina	$C_6H_3Cl_2H_2N$.
Trichloranilina	$C_6H_2Cl_3H_2N$.
Bromanilina	$C_6H_4BrH_2N$.
Iodinanilina	$C_6H_4IH_2N$.
Cyananilina	$C_6H_4CyH_2N$.†
Nitranilina	$C_6H_4NO_2H_2N$.

But it is not only the hydrogen of NH_3 which can be replaced by elements or compounds; even the nitrogen may thus be substituted by elements, the chemical compounds of which show a close analogy to the corresponding compounds of N. Phosphorus, arsenic, and antimony form with 3H hydrurets, analogous in composition to NH_3, but without basic character. When the hydrogen is replaced by any of the alcohol radicals methyle, ethyle, etc., the compounds, like $P(C_2H_5)_3$, are weak bases, and combined with 1 or 2O have a stronger basic character; the corresponding nitrogen compounds NH_3O are still unknown. Strong basic properties are met with in the compounds analogous to NH_4O, in which 4H are replaced by alcohol radicals; the oxide of stibmethylium, $Sb(CH_3)_4O$, for instance, is extremely caustic, decomposes the salts of ammonia and metallic oxides like potassa; its salts are bitter, not poisonous, and isomorphous with the potassium salts.

The chemical behavior of all the organic bases is closely allied to ammonia; if we omit *tannic acid*, which is not precipitated by NH_3, but yields precipitates insoluble in water, not only with the vegetable alkalies but also with most neutral principles (*see* Chapter IX.), there are particularly five reactions characteristic of this class:—

1. The residue of the treatment of uric acid with nitric acid is of a reddish color, and dissolves in ammonia with a beautiful purple, forming murexid. Precisely similar is the behavior of the organic alkaloids, though, from their different composition, this color is somewhat altered; nicotia produces the purest purple, anilina a more violet color (Schwarzenberg).

2. Their behavior to Sonnenschein's test is alike. Whether free or combined with an acid, all alkaloids of the combination of ammonia are precipitated by *phospho-molybdic* acid with various shades of yellow, some pulverulent, some flocculent, some voluminous. The following exhibits his results:—

The precipitate is:—

Light yellow and flocculent with morphia, veratria, jervia, aconitia, emetia, atropia, daturia, ethylamina, diethylamina, triethylamina, methylamina, dimethylamina, trimethylamina, and anilina.

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* Similar combinations are formed with amyle, butyle, and other carbo-hydrogens.

† Chlorine, bromine, iodine, etc., in the proportion of two atoms, are less basic, and where three atoms enter into the compound, it ceases to have basic properties.

Light yellow and voluminous with caffeina, theobromina, conia, nicotia.
" " " *pulverulent* with mercuramina.
Yellowish-white and flocculent with quinia and cinchonia.
" " " *voluminous* with strychnia.
Brownish-yellow and flocculent with narcotina and piperina.
" " " *voluminous* with codeia.
Ochre-yellow and flocculent with brucia.
Dirty-yellow and flocculent with berberina.
Orange-yellow and flocculent with colchicia.
Sulphur-yellow and flocculent with sinamina.
Lemon-yellow and flocculent with quinolina.
" " " *pulverulent* with solania.

3. Another very important test for the discovery of the alkaloids is Scheibler's *phospho-tungstate of sodium.*

The reagent is prepared by adding phosphoric acid to tungstate of sodium, and has been, as far as experiments performed on dogs are reliable, recommended as an antidote to poisonous alkaloids, with which an insoluble compound is formed, that cannot be assimilated.

These precipitates are all insoluble or nearly so in water, alcohol, ether, and in diluted mineral acids, with the exception of phosphoric. Concentrated nitric, acetic, tartaric, citric, and oxalic acids dissolve them on boiling, separating them again on cooling; citric acid, however, easily reduces the phospho-molybdic acid. Caustic alkalies, their carbonates, borates, phosphates, tartrates, and acetates, dissolve the precipitates, some separating again the organic alkali. The oxides of the earthy metals, silver and lead, and their carbonates gradually decompose them, liberating the base. .00007 gramme of strychnia in one cubic centimetre of solution is very plainly precipitated. A solution containing only $\frac{1}{200000}$ part of strychnia is rendered opalescent.

Asparagin, sinapolin, urea, hydrocyanic, hippuric, uric, and similar acids, and nitrogenous bodies, digitalin, meconin, and similar organic neutral principles are not precipitated.

4. Similar in its behavior to the alkaloids is Schultze's test liquid, which is prepared by adding pentachloride of antimony to phosphoric acid; the precipitates are usually white and flocculent and insoluble in diluted acids.

5. The fifth general test for alkaloids is that of Prof. F. F. Mayer, who uses *iodo-hydrargyrate of potassium*, or rather a solution of corrosive sublimate in iodide of potassium. It precipitates ammonia only in the presence of free alkali, but the vegetable alkalies are precipitated from neutral alkaline and acid solutions, and the precipitates are soluble in alcohol. In recommending this test for the quantitative determination of alkaloids in pharmaceutical preparations, Prof. Mayer observes that aconitia and berberina require, for complete precipitation, 1 equivalent; atropia, strychnia, brucia, narcotina, and veratria, 2; morphia and conia 3; nicotia 4; and the cinchona alkaloids 6 equivalents of mercury. (See *Proc. American Pharm. Association*, 1862, 238.)

For chemico-legal analyses Sonnenschein proposes the following easy way of detecting the alkaloids. The substances are treated

with water strongly acidulated with muriatic acid several times until exhausted, evaporated at about 90° F., to a thin syrupy consistence, diluted with water, after standing, filtered; precipitated by phospho-molybdic acid in excess, the precipitate washed with water on a filter, acidulated with nitric and phospho-molybdic acid, mixed with hydrate of baryta to alkaline reaction, and heated in a flask with a tube attached to collect ammonia and other volatile bases in muriatic acid. The residue is treated with carbonic acid, evaporated, exhausted with alcohol and evaporated; if necessary, recrystallized to purify the bases.

The phospho-molybdic acid is prepared by precipitating molybdate of ammonia with phosphate of sodium, the yellow precipitate is well washed with water, suspended in water, and dissolved by carbonate of sodium, evaporated and heated to expel ammonia; if reduction should take place, it is moistened with HNO_3, and again heated to redness; the mass is then dissolved in warm water and mixed with HNO_3 to strong acid reaction, and diluted to ten times the weight of the dry salt; after filtering it has a golden yellow color; it must be preserved against ammoniacal vapors.

Besides the method by phospho-molybdic acid as above, the following older method of testing for the alkaloids, first proposed by Stas, has been more frequently tried and found successful.

The substance is mixed with twice its weight of pure strong alcohol and a little tartaric or oxalic acid, and heated to 160° to 165° F., after cooling, filtered, washed with strong alcohol, and the liquors evaporated below 95° over sulphuric acid or in a current of air; the remaining aqueous liquid is passed through a wetted filter to separate fats, and again evaporated to near dryness; the product is exhausted with cold 95° per cent. alcohol, evaporated, dissolved in very little water, bicarb. sodium or potassium added until carbonic acid ceases to be evolved, and agitated with four or six times its measure of rectified ether free from oil of wine. The residue, after evaporation of some of the ethereal solution, shows the presence of either a liquid or solid alkaloid. If the former, the ether is shaken with a little of a strong solution of caustic soda or potassa, decanted, the residue washed with ether, the liquids mixed with a little diluted H_2SO_4. This ether then contains the animal substances, the water, the salts of nicotia, conia, and ammonia; sulphate of conia is slightly soluble in ether. The aqueous solution is decomposed by potassa and agitated with ether, the ether evaporated spontaneously; to get rid of all traces of ammonia, the residue is placed for a moment in vacuo over H_2SO_4. Conia and nicotia may be easily distinguished by their odor; conia is insoluble, nicotia soluble in water. In water mixed with conia, a few drops of chlorine water produce a white precipitate.

If the alkaloid be solid, the ethereal solution is treated with soda or potassa, decanted, washed with much ether, evaporated, dissolved in a little alcohol, evaporated, dissolved in water acidulated with H_2SO_4, evaporated in vacuo or over sulphuric acid, treated with

pure carbonate of potassium, then with absolute alcohol, which, on evaporation, yields the alkaloid crystallized. If, after the decomposition by an alkali, the addition of ether is delayed, morphia, which immediately after precipitation is more soluble, becomes crystalline, and ether then takes up but traces of it; alcoholic ether, however, takes up larger quantities of morphia. Otto therefore advises to add more soda to the washed (with ether) solution to prevent crystallization of morphia, then add muriate of ammonia, when, on evaporation, all morphia will crystallize out.

The volatile alkaloids, besides being obtained by means of ether, are obtained by distilling the aqueous acid solution with soda.

Uslar and J. Erdmann obtain the alkaloids in a nearly pure state, by decomposing the acid infusion with an alkali and shaking with amylic alcohol, from which the base is extracted by agitating it with much water acidulated with muriatic acid. This method is recommended for obtaining these bodies for forensic purposes or from the plants containing them. (See *Amer. Journ. Ph.*, 1862, 354.)

Meconic Acid.—For the detection of opium, it is not necessary to isolate the organic alkalies, since the reaction of meconic acid with sesquichloride of iron is unmistakable evidence of its presence. The substance is treated with alcohol and a few drops of muriatic acid, evaporated, dissolved in water, filtered, boiled with excess of magnesia, filtered, acidulated with muriatic acid, and a solution of sesquichloride of iron added; a deep brown-red coloration which is not affected by terchloride of gold indicates the presence of meconic acid.

1. *Syllabus of Natural Quaternary Alkaloids.*

Ranunculaceæ.		
Aconitum Napellus.	Aconiti folia, *U. S.*	Aconitia, $C_{17}H_{23}NO_3$.
	" radix, "	Napellina, ?
Delphinium staphisagria.	Staphisagria.	Delphinia, $C_{27}H_{32}NO_2$.
" consolida	Delphinium, *U. S.*	Staphisaina, $C_{11}H_{23}NO$.
Hydrastis Canadensis.	Yellow root.	Hydrastia, ?
		Berberina, $C_{20}H_{17}NO_4$.
Helleborus niger.	Helleborus, *U. S.*	Helleboria, ?
Coptis trifolia.	Coptis, *U. S.*	Berberina, $C_{20}H_{17}NO_4$.
" Teeta.	Mahmira.	
Xanthorrhiza apiifolia.	Xanthorrhiza, *U. S.*	
Menispermaceæ.		
Cissampelos pareira.	Pareira, *U. S.*	Cissampelina, $C_{18}H_{21}NO_3$.
Anamirta cocculus.	Cocculus Indicus.	Menispermina, $C_{18}H_{12}NO_2$.
Cocculus palmatus.	Calumba, *U. S.*	Berberina, $C_{20}H_{17}NO_4$.
Coscinium fenestratum.	Columbo wood.	
Menispermum Canadense.	Yellow parilla.	
Anonaceæ.		
Codocline polycarpa.		Berberina.
Berberideæ.		
Berberis vulgaris.	Barberry root.	Berberina, $C_{20}H_{17}NO_4$.
		Berbina.
Jeffersonia diphylla.	Twinleaf.	Berberina.
Podophyllum peltatum.	Podophyllum, *U. S.*	

	Papaveraceæ.	
Papaver somniferum.	Opium, *U. S.*	Morphia, $C_{17}H_{19}NO_3,H_2O$. Narcotina, $C_{22}H_{23}NO_7$. Codeia, $C_{18}H_{21}NO_3,H_2O$. Thebaia, $C_{19}H_{21}NO_3$. Narceina, $C_{23}H_{29}NO_9$. Opiania, $C_{21}H_{21}NO_7$. Papaverina, $C_{20}H_{21}NO_4$. Phormia, $C_{27}H_9NO_7$. Opina, ? Metamorphia, ? Apomorphia, $C_{17}H_{17}NO_2$.
Sanguinaria Canadensis.	Sanguinaria, *U. S.*	Sanguinarina, $C_{36}H_{64}N_4O_8$.
Chelidonium majus.	Celandine.	Chelidina, $C_{40}H_{20}N_3O_3$. Puccina, ?
Glaucium luteum.	Horn poppy. (The herb.)	Glaucina, ? Gaucina, ?
	Fumariaceæ.	
Corydalis fabacea, bulbosa, tuberosa, and formosa.	Turkey corn, etc.	Corydalina, $C_{20}H_{26}NO_7$.
Fumaria officinalis.	Fumatory.	Fumerina, ?
	Violaceæ.	
Viola odorata.	Viola, *U. S.*	Violia, ?
Anchieta salutaris.		Anchietia, ?
	Byttneraceæ.	
Theobroma cacao.	Chocolate nut.	Theobromia, $C_7H_8N_4O_2$.
	Camelliceæ.	
Thea Bohea.	Chinese tea.	Theina identical with caffeina. (*See* Celastrineæ and Cinchonaceæ.)
	Sapindaceæ.	
Paullinia sorbilis.	Guarana.	
	Rutaceæ.	
Peganum harmala.	Harmel rue.	Harmalina, $C_{13}H_{14}N_2O$. Harmina, $C_{13}H_{12}N_2O$.
Xanthoxylum Clava Herculis.	West Indian Prickly ash.	Berberina, $C_{21}H_{19}NO_5$.
	Celastrineæ.	
Ilex Paraguayensis.	Paraguay tea.	Caffeina. (*See* Cinchonaceæ.)
	Leguminosæ.	
Geoffroya Jamaicensis.	Jamaica cabbage-tree bark.	Jamaicina, ?
" Surinamensis.	Surinam " "	Surinamina, ?
Baptisia tinctoria.	Wild indigo.	Baptisina, ?
	Umbelliferæ.	
Conium maculatum.	Conium, *U. S.*	Conhydrina, $C_8H_{17}NO$. (*See* Conia among the ternary alkaloids.)
Æthusa cynapium.	Fool's parsley.	Cynapia, ?
	Cucurbitaceæ.	
Trianosperma ficifolia.	Tayuya.	Trianospermia, ?
	Monimiaceæ.	
Atherosperma moschatum.	The bark.	Atherospermia, $C_{30}H_{40}NO_5$.
	Erythroxylaceæ.	
Erythroxylon Coca.	Coca leaves.	Cocaina, $C_{16}H_{20}O_4$. (*See, also,* Ternary Alkaloids.)
	Cinchonaceæ.	
Various Peruvian barks of the genus Cinchona.	Cinchona, *U. S.*	Quinia, $C_{20}H_{24}N_2O_2,3H_2O$. Quinidia, $C_{20}H_{24}N_2O_2,2H_2O$. Cinchonia, $C_{20}H_{24}N_2O$. Cinchonidia, $C_{20}H_{24}N_2O$.
Jaen and Cusco bark. Para bark. Pitaya bark. Carthagena bark.	Unofficinal barks.	Aricia, $C_{23}H_{27}N_2O_4$. Paricia, ? Pitayia, ? Carthagia, ?

Cephaëlis ipecacuanha.	Ipecacuanha, *U. S.*	Emetia, $C_{20}H_{30}NO_5$.
Coffea Arabica.	Coffee.	Caffeina, Theina, $C_8H_{10}N_4O_2H_2O$.
	Compositæ.	
Eupatorium cannabinum.	Water hemp.	Eupatorina, ?
	Apocynaceæ.	
Strychnos nux vomica.	Nux vomica, *U. S.*	Strychnia, $C_{21}H_{22}N_2O_2$.
" Ignatia.	Ignatia, *U. S.*	Brucia, $C_{23}H_{26}N_2O_4 4N_2O$.
		Igasuria, $C_{22}H_{26}N_2O_4$.
Geissospermum Vellosi?	Pao pereira.	Pereirina, ?
Urari or Curare.	Arrow poison.	Curaria, ?
	Verbenaceæ.	
Vitex Agnus castus.	Chaste tree.	Castina, ?
	Convolvulaceæ.	
Convolvulus Scammonia.	Scammonium, *U. S.*	Convolvulina, ?
	Solanaceæ.	
Solanum dulcamara and other species.	Dulcamara, *U. S.*	Solania, ? Dulcamarina, ?
Atropa belladonna.	Belladonna, *U. S.*	Atropia, $C_{17}H_{23}NO_3$.
		Belladonnia, "
Datura stramonium.	Stramonium, *U. S.*	Daturia, identical with atropia.
Hyoscyamus niger (and albus).	Hyoscyamus, Folium and Semen, *U. S.*	Hyoscyamia.
Capsicum annuum.	Capsicum, *U. S.*	Capsicina.
	Euphorbiaceæ.	
Buxus sempervirens.	Boxwood.	Buxina, = Bebeerina.
Croton tiglium.	Croton seed.	Crotonina, ?
Euphorbia officinarum.	Euphorbium.	Euphorbina, ?
	Lauraceæ.	
Nectandra Rodiei.	Bebeeru bark.	Bebeerina, $C_{19}H_{21}NO_3$.
		Sepeerina, ?
	Piperaceæ.	
Piper nigrum (longum and album).	Piper, *U. S.*	Piperina, $C_{34}H_{38}N_2O_6$.
Piper caudatum.	Cubeba Clusii.	
	Melanthaceæ.	
Veratrum album, sabadilla viride.	Veratrum album, *U. S.*	Veratria, $C_{32}H_{52}N_2O_8$.
	Veratrum viride, *U. S.*	Sabadillia, $C_{20}H_{26}N_2O_5$.
	Sabadilla, *U. S.*	Jervia, $C_{30}H_{46}N_2O_3$.
Colchicum autumnale.	Colchicum, *U. S.*	Colchicia, ?
	Palmæ.	
Cocos lapidea.		Apirina, ?

2. *Syllabus of Artificial Quaternary Alkaloids.*

Quinicia, $C_{20}H_{24}N_2O_2$.	From quinia and quinidia.	(*See* Cinchona Alkaloids.)
Cinchonicia, $C_{20}H_{24}N_2O_2$.	From cinchonia and cinchonidia.	
Tropia, ?	From atropia.	
Porphyrharmina, ?	From harmalina and harmina.	

3. *Native Ternary Alkaloids.*

	Leguminosæ.	
Spartium scoparium.	Scoparius, *U. S.*, Broom.	Sparteina, $C_{10}H_{26}N_2$.
	Umbelliferæ.	
Conium maculatum.	Conium, *U. S.*, Hemlock.	Conia, $C_8H_{15}N$.
		Methylconia, $C_9H_{17}N$.
		Ethylconia, $C_{10}H_{19}N$.
Cicuta virosa.	Water hemlock.	Cicutina, ?

Chærophyllum bulbosum.	Cowparsley.	Chærophyllina, ?
	Rubiaceæ.	
Araribe rubra.		Aribina, $C_{23}H_{20}N$.
	Erythroxylaceæ.	
Erythroxylon coca.	Coca leaves.	Hygrina, ?
	Lobeliaceæ.	
Lobelia inflata.	Lobelia, *U. S.*	Lobelina.
	Solanaceæ.	
Nicotiana tabacum.	Tabacum, *U. S.* Tobacco.	Nicotia, $C_{10}H_{14}N_2$.
	Euphorbiaceæ.	
Mercurialis annua.		Mercurialina, ?
	Rosaceæ.	
Pyrus communis.	Flowers Sorbus aucuparia, Cratægus monogyna and oxycantha.	
	Chenopodeæ.	Secalina, or Propylamina. NC_3H_9.
Chenopodium vulvaria	Herb	
	Fungi.	
Secale cornutum.	Ergota, *U. S.*	

Ecbolina. Obtained by precipitating cold aqueous infusion of ergot with acetate of lead, precipitating lead with H_2S, filtering and concentrating, then precipitating with HCl_2 until no further precipitate falls, and filtering. The muriate thus obtained is decomposed by phosphate of silver; the chloride of silver and excess of phosphate are filtered out, and lime added to neutralize the phosphoric acid combined with the ecbolina, and the lime removed by CO_2. The liquid is then concentrated with a gentle heat.

Ergotina. Obtained by treating the liquid left by precipitating with HCl_2 with phospho-molybdic acid, washing the precipitate obtained, and suspending it in water with an excess of carbonate of barium until the yellowish color has changed to pure white, with the evolution of CO_2. It remains only to evaporate gently to obtain the ergotina.—*Amer. Jour. Pharmacy*, 1864, p. 193.

4. *Artificial Ternary Alkaloids.*

(a) *By Decomposition of Native Alkaloids, mostly with Potassa or other Alkalies.*

Conia, $C_8H_{15}N$. From conhydrina by anhydrous phosphoric acid.

Ethylamina, $C_2H_5H_2N$. From narcotina; thin colorless liquid, boiling at 66° F.; strong ammoniacal odor; burning with a yellow flame; miscible with water; strong base.

Propylamina, C_3H_7N. From narcotina and codeia. (*See* Secalina.)

Methylamina, CH_5N. From narcotina, codeia, morphia, caffeina by potassa; a liquefiable gas, ammoniacal odor; very soluble in water; burns with a yellow flame; strong base.

Piperidina, $C_5H_{11}N$. From piperina by a mixture of soda and lime.

(b) *From Alkaloids, and in Coal Tar.*

Lepidina, C_5H_9N. From cinchonia by potassa; colorless oil; distils at 500°.

Pyridina, C_5H_5N. Like former; distils at 242°; soluble in water.

Lutidina, C_7H_9N. Like former; distils at 310°; aromatic oil separated from its aqueous solution by heating.

Pyrrolina, C_4H_5N. Like former; distils at 271°; agreeable ethereal odor; colors pine-wood moistened with HCl carmine red; turns red with HNO_3.

Quinolina or Leucolina, C_9H_7N. From quinia, cinchonia, strychnia, berberina by potassa; oily; disagreeable bitter-almond odor; distils at 462°; dissolves much water, in which it is little soluble.

Picolina, C_6H_7N. From piperina and cinchonia by potassa; distils at 275°; pine-wood is colored yellow.

(c) *From other Sources.*

Toluidina, C_7H_9N. From nitrotoluol by NH_3 and HS; from oil of turpentine by HNO_3 and KO; little soluble in water, easily in other solvents; liquid at 104°; boiling at 388°; intensely yellow with pine-wood.

Anilina, C_6H_7N. From coal tar; from indigo by KO; from nitrobenzol by HS and NH_4S, etc.; vinous odor; aromatic taste; boiling point 360°; by HNO_3 deep blue, yields picric acid. Synonyms: crystallin, benzidamin, phenylamin.

Aconitia. ($C_{17}H_{23}NO_3 = 289.$)

The outlines of the process of the *Pharmacopœia* for preparing this alkaloid are as follows: Forty-eight troyounces of aconite root in moderately fine powder are exhausted by alcohol, the alcohol is distilled off until a pint remains behind, which is diluted with a pint of distilled water, to which a fluidounce and a half of dilute sulphuric acid has been added. The fixed oil and resin, which separate on standing, are now removed from the liquid, and this is evaporated to four fluidounces; this is washed, after cooling, by agitation and decantation, with six fluidounces of stronger ether to remove the remainder of the fixed oil and resin. Stronger water of ammonia is now added in slight excess, and the mixture is three times successively agitated with six fluidounces of stronger ether; the ethereal solutions, after decantation, are mixed, and, in a porcelain capsule, evaporated spontaneously to dryness. The dry residue is reduced to powder and kept in well-stopped bottles.

Aconitia, thus prepared, is a yellowish-white powder, without smell, and of a bitter acrid taste, accompanied with a sense of numbness. It melts at a moderate heat, and, at a high temperature, is decomposed and entirely dissipated with the smell of ammonia. It requires 150 parts of cold and 50 parts of boiling water for solution, and is readily dissolved by alcohol, ether, and chloroform. It neutralizes acids, forming with them uncrystallizable salts.

By this process aconitia is obtained in an impure state, though sufficiently pure for medicinal purposes. Even when pure it crystallizes with great difficulty. Its salts are readily soluble in water and alcohol, and are precipitated by bichloride of mercury, terchloride of gold, and sulphocyanide of potassium, but not by bichloride of platinum; solution of iodine produces a brown-red precipitate; concentrated sulphuric acid colors it yellow, afterwards violet; with nitric acid it produces a colorless solution.

Aconitia is one of the most virulent of poisons, and extreme caution is necessary if used internally. Externally applied, it produces on the skin a prickling sensation followed by numbness and a feeling of constriction. Its principal use is in cases of neuralgia, in ointment made by triturating the alkaloid first with a little alcohol or oil, and then with an unctuous vehicle. From a half to two grains are added to one drachm of the ointment. The galenical preparations of aconite perhaps answer every useful purpose to which aconitia can be applied.

Napellina occurs in the genus Aconitum, with aconitia in very small proportion. It may be obtained from the crude aconitia,

which is treated with a little ether; the residue is dissolved in absolute alcohol, precipitated by acetate of lead, and the filtrate treated with sulphuretted hydrogen, then with carbonate of potassium, evaporated, exhausted by absolute alcohol, and decolorized by animal charcoal. It is a white electrical powder, of a bitter, afterwards burning taste; pure ether dissolves it with some difficulty. It is distinguished from aconitia by not being precipitated by ammonia from its diluted solution in muriatic acid, and by being more soluble in dilute alcohol and water.

Delphinia, $C_{27}H_{32}NO$.—The alcoholic extract of the seed of Delphinium staphisagria is treated with dilute sulphuric acid, precipitated with an alkali, again dissolved in diluted sulphuric acid, the coloring matter precipitated by a few drops of nitric acid, and the alkaloid by potassa; it is then obtained by evaporation of its solution in absolute alcohol. One pound yields about one drachm.

It is a light yellowish or white powder; its taste is burning, acrid, very persistent in the throat; it is soluble in alcohol and ether, fuses at 248° F., and is decomposed at 300°, turning green; the salts are neutral, bitter, and acrid, some deliquescent.

Staphisaina.—If delphinia is dissolved in ether, this alkaloid remains behind as a yellowish, uncrystallizable mass, of an acrid taste, which forms acid salts.

Hydrastia may be prepared by treating the aqueous extract of hydrastis with magnesia, and extracting the precipitate with boiling alcohol.

Prof. Wayne, of Cincinnati, prepares a cold infusion of the root, removes the berberina by muriatic acid, and precipitates hydrastin by an alkali, recrystallizing it from alcohol.

This vegetable alkali was discovered by Alfred B. Durand, of Philadelphia, in 1850, while investigating the composition of the root of Hydrastis Canadensis. It forms yellow crystals, insoluble in water, sparingly soluble in cold alcohol and ether, soluble in chloroform and boiling alcohol, fusible in heated turpentine; it has an alkaline reaction on litmus; by concentrated nitric acid it is colored deep red. Concentrated sulphuric acid has little action in cold; when heated a purple color is produced; concentrated muriatic acid dissolves it.

The salts, which are intensely bitter, have not been obtained in crystals.

Hydrastia is stated by the "Eclectics" to be a valuable tonic, which has an especial action on diseased mucous tissues. It is very rarely prescribed.

Helleboria is obtained by treating the root with alcohol containing one-fiftieth sulphuric acid; the tincture is treated with magnesia, the filtrate acidulated with sulphuric acid, water is added, the alcohol distilled off, filtered, decomposed with carbonate of potassium, and by shaking with ether, the alkaloid obtained in solution. It is white, crystalline, easily soluble in water, alcohol, and ether; taste bitter and acrid; not volatile; as it evolves ammonia when

treated with potassa, its proper place appears to be among the alkaloids, though its chemical nature is not known.

Cissampelina or Pelosina, $C_{18}H_{21}NO_3$.—It is prepared by carefully precipitating an infusion of the root made with sulphuric acid water, washing, drying at 212°, and dissolving in absolute ether, which is free from alcohol and water.

The yellowish, hard, semitransparent mass is colored yellow by sunlight; without smell; taste disagreeably sweetish-bitter; soluble in alcohol and ether; insoluble in water, but swelling up and combining with it; in this state it has an alkaline reaction.

The alkaloid and its salts are rapidly oxidized in a moist atmosphere; ammonia is evolved and they turn yellow; anhydrous alcohol now dissolves the new base *pelluteina*, $C_{24}H_{42}NO_7$, which is insoluble in ether.

Menispermina, $C_{18}H_{12}NO_2$, is contained in the shell of Cocculus Indicus. To prepare it, the alcoholic extract is first extracted by cold water, then by hot water, from which solution mineral acids precipitate picrotoxic acid in crystals; the filtrate is precipitated by an alkali, the precipitate extracted with acetic acid, again precipitated, washed with cold alcohol, and the alkaloid extracted by ether.

It crystallizes in needles or prisms, has a very bitter taste, fuses at 248° F., is soluble in alcohol, ether, and alkalies, little in water, and is said to be not poisonous.

Berberina, $C_{20}H_{17}NO_4$, is one of the most widely diffused organic alkalies, having been found in several genera and species of not less than five natural orders. It is prepared from the aqueous extract of barberry root by treating it with 82 per cent. alcohol, distilling it off, crystallizing the alkaloid in a cool place, and purifying it by recrystallization. By a similar process it may be obtained in large proportion from colombo wood, the wood of Coscinium fenestratum, a tree growing in Ceylon.

As stated above, berberina is likewise obtained from the infusion of hydrastis by precipitating its muriate by an excess of muriatic acid. The eclectics called this salt a resinoid, and named it hydrastin. Prof. Mahla, of Chicago, proved its true chemical nature. (*Amer. Journal of Sciences and Arts*, January, 1862.)

For accounts of the presence of berberina and its mode of extraction from other American plants, we have to refer to the interesting papers of Prof. F. F. Mayer (*Amer. Journ. of Pharm.*, 1863, p. 97); of J. M. Maisch (Ibid., p. 301 and 303), and of J. D. Perrins (Ibid., p. 456).

It crystallizes in fine yellow needles, containing 12 Aq., ten of which are expelled at a temperature of 212°, possesses a strongly bitter taste, is insoluble in ether, easily soluble in boiling water and alcohol. By concentrated sulphuric acid it is dissolved with an olive-green color; by concentrated nitric acid, red, with nitrous acid fumes; ammonia colors it yellowish-brown; by distillation with lime it yields quinolina.

It is a dye for silk, cotton, wool, and linen. Its salts have a

yellow color, are crystallizable and precipitated by iodide, bromide, cyanide, ferrocyanide, and sulphocyanide of potassium, by bichloride of mercury and of platinum; the neutral salts are soluble in water, but insoluble in dilute acids.

Berberinæ Murias (*Muriate of Berberina*), HO,HCl.—This salt has been used by the Eclectics under the name of hydrastin. (See *Amer. Journ. Pharm.*, 1862, pp. 141, 308, and 360.) It is obtained from the concentrated infusions of plants containing this alkaloid by precipitating with an excess of muriatic acid and recrystallizing from hot alcohol. It occurs in bright yellow crystals, containing 5 equivalents of water of crystallization, which is expelled at 212°. It has been used as a tonic in doses of 3 to 5 grains.

If berberina is exposed to the influence of nascent hydrogen, a colorless base is obtained, named by its discoverers *hydroberberina*, $C_{20}H_{21}NO_4$. By oxidizing agents it is readily reconverted into berberina.

Berbina (*Oxyacanthin.*)—The bark of barberry root is extracted with alcohol, mixed with one-eighth water, the alcohol distilled off, the filtrate evaporated, berberina crystallized out, the mother-liquor precipitated by carbonate of sodium, and the precipitate treated with sulphuric acid and animal charcoal.

White powder, colored brown by sunlight, bitter; nearly insoluble in water, soluble in alcohol, ether, fixed and volatile oils.

The salts are crystallizable, colorless, bitter.

Many of the plants in which berberina is found, in a larger or smaller proportion, contain also a colorless or white alkaloid, which is generally soluble in ether. It is uncertain yet whether these alkaloids are alike in the different plants, and whether they stand in any relation to berberina. (*See* the papers of Profs. Mayer and Maisch, above referred to.)

The Opium Alkaloids and their Salts.

The various kinds of opium, as produced in different localities, always contain morphia, on which the activity of the drug mainly depends; narcotina and other alkaloids are also always present, but some species contain, besides them, one or two alkaloids which have not been found in opium as generally produced. Besides the acid and a neutral principle, there have been discovered nine distinct vegetable alkalies, some of which are still little known.

Morphia. $C_{17}H_{19}NO_3 + H_2O = 303$.

Morphia, which is the only one of the opium alkaloids commonly used in medicine, is the most abundant. It is the best known and most familiar of the whole class of vegetable alkalies.

There are various processes for its preparation, of which that of the *Pharmacopœia* is the simplest for the student who may be disposed to attempt this by no means difficult experiment.

Reduced in quantity to suit the purpose, it is nearly as follows:—

Take of	Opium, sliced	℥j.
	Solution of ammonia	f℥ss.
	Distilled water,	
	Alcohol,	
	Animal charcoal, in fine powder, of each	Sufficient.

Macerate the opium with f℥vj of water, working it with the hands or a pestle, as described under the head of Tincture of Opium, into a paste (if powdered opium is used, this is unnecessary); then digest it for twenty-four hours, and strain. Macerate or digest the residue in the same way, successively, with similar portions of water, and strain; then mix the infusions, evaporate to f℥viij, and filter. To the concentrated aqueous solution thus obtained add first f℥vj of alcohol, and then f℥ij of solution of ammonia, previously mixed with about f℥ss of alcohol; cover the vessel and set it aside. After twenty-four hours pour in the remaining f℥ij of solution of ammonia, mixed, as before, with alcohol, and again set aside that the morphia may crystallize out. The only remaining process is to purify the crystals which are formed in the bottom of the vessel. This is done by dissolving them in boiling alcohol, and filtering, while hot, through animal charcoal. A common flask will serve for the solution, and, for small operations, the application of heat to the funnel will be unnecessary. It may be conveniently arranged over an evaporating dish. The filtered liquid, as it falls, will be immediately cooled by contact with the dish, and the extended surface will favor the spontaneous evaporation of the alcohol, so that a small crop of crystals (40 to 60 grains) of morphia may be expected.

This is a convenient method of testing, approximately, the value of specimens of opium, in which case it is not necessary to carry out the last part of the directions, but is as well to take the weight of the crystallized alkaloids as at first thrown down. The animal charcoal deprives the product of color, but is apt to absorb a portion of alkaloid also; so that, to get the entire yield, the charcoal should be digested in a further portion of alcohol, which should be added to the filtrate. The motive for using alcohol with the ammonia added to the concentrated liquid in the first instance, is to take up the resinous coloring matters, which would otherwise contaminate the precipitate.

This method, however, can lay no claims to accuracy. Narcotia is exhausted by water together with morphia, and ammonia precipitates both these alkaloids, while the third one, codeia, remains in the mother-liquor if this be not too concentrated. Morphia is not entirely insoluble in water, and dissolves more freely in alcoholic liquids, in which narcotina is soluble to a less extent. The precipitate obtained by the above process, therefore, contains notable quantities of narcotina, while a portion of morphia remains in the alcoholic mother-liquor.

A better method for assaying opium, which may likewise be used for preparing pure morphia on a small scale, is based on its solubility in fixed alkalies. It was originally proposed by Thiboumery

and improved by Mohr as follows: One part of opium is exhausted by macerating it with twelve parts of cold water in four successive portions; the infusion is heated to boiling and mixed with hot milk of lime containing one-sixth caustic lime. The mixture is boiled for a few minutes, strained, the residue expressed, the liquid evaporated to two parts, filtered, heated to boiling, and mixed with one-twelfth part of chloride of ammonium. Ammonia is freely given off and the morphia separates in a crystalline state in a nearly white condition, the lime having removed most of the coloring matter.

Boussingault and Payen follow a similar method, except that they neutralize the alkaline liquor by muriatic acid and precipitate the alkaloid by ammonia.

The greatest difficulty with this process consists in the sparing solubility of lime and the possible loss of some morphia by the absorption of some carbonic acid by the lime, if the alkaline solution becomes too concentrated. Herzog substitutes potassa for lime, and perhaps a still greater improvement is the employment of caustic baryta by Prof. F. F. Mayer.

Morphia occurs in small but brilliant prismatic crystals, containing $2H_2O$, or nearly six per cent., which are transparent and colorless, intensely bitter when dissolved. It dissolves in about 1000 parts of cold and 400 parts of boiling water, in 14 parts of boiling and 20 of cold alcohol, freely also in solutions of fixed alkalies, while ammonia dissolves but little, and with great facility in dilute acids, which it neutralizes, forming salts; one hundred parts of chloroform dissolve .57 of morphia. It is insoluble in ether. Heated with caustic potassa, methylamin is evolved.

In powder, it strikes a deep blue color with neutral salts of sesquioxide, or with sesquichloride of iron, decomposes iodic acid with liberation of iodine, the yellow or reddish-yellow color being considerably deepened by the addition of a few drops of ammonia, and forms with nitric acid a red compound passing into yellow; with nitric containing some sulphuric acid, it strikes a green color; chlorine colors morphia diffused in water orange, then red, and after solution yellow, and ultimately causes a flocculent precipitate.

Morphia may be considered pure, if it is entirely dissipated by heat, if ether takes nothing up, if it is wholly soluble in alcohol, and when its solution in diluted nitric acid is not precipitated by nitrate of silver, nitrate of barium, phosphate and oxalate of ammonium.

Morphia Salts.—These are mostly crystallizable, soluble in water and alcohol and insoluble in ether; their solutions have a very bitter taste and are precipitated by alkalies and their carbonates, sulphocyanide of potassium, and terchloride of gold, in which case the latter is reduced to the metallic state. Concentrated solutions are also precipitated by iodide of potassium, phosphate of sodium, bichloride of platinum, and bichloride of mercury.

They are made by forming solutions of the alkaloids in the appriate acids and evaporating.

Morphiæ Sulphas.—This is in white feathery crystals, soluble in about 2 parts of hot water. In the United States it is by far the most common of the morphia salts; it contains 5 equivalents of water. Dose, one-eighth to one-fourth grain.

Morphiæ Murias.—This is most used in England, where it is officinal as morphiæ hydrochloras. It is soluble in about 20 parts of cold water. Dose, the same as of the sulphate.

Morphiæ Acetas.—By treating morphia with alcohol and acetic acid and precipitating by ether, it is obtained in crystals, but usually it is a white powder, and deficient in the proportion of the acid ingredient, so as to be comparatively insoluble, in which case a few drops of acetic acid to the liquid will make a clear solution. It is very freely soluble in water, less in alcohol, and is much used for external application, though adapted also to the form of powder or pill. Dose, the same as of the foregoing.

Morphiæ Citras.—In some parts of the United States a solution of this salt is employed. It is prepared by dissolving 16 grains of morphia with 8 grains citric acid and $\frac{1}{4}$ grain cochineal in one ounce of water. It is considered $2\frac{1}{2}$ times stronger than laudanum; its dose is 10 drops.

Morphiæ Valerianas is an unofficinal salt, made by neutralizing the alkaloid with valerianic acid. Its dose is from one-eighth to one-half grain.

Narcotina, $C_{22}H_{23}NO_7 + H_2O$ (equiv. 431), is easily obtained by extracting aqueous extract of opium or crude morphia with ether, which leaves it, on evaporation, nearly pure. It crystallizes in colorless crystals, nearly insoluble in water, in fixed alkalies, and in a solution of table salt; it dissolves in 20 parts of hot and 150 parts cold alcohol; its alcoholic solution is very bitter, but has no alkaline reaction; 100 parts of chloroform dissolve 37.17 parts, and 1 ounce of olive oil 1.2 grain of narcotina; it is not acted on by sesquisalt of iron or pure nitric acid, but sulphuric, with but a trace of nitric acid, colors it blood-red. Its salts are generally acid and crystallize with difficulty. Narcotina is not narcotic. It has been given as a tonic and antiperiodic, in doses as high as half a drachm, without the production of narcotic symptoms. The following four homologous varieties of narcotina have been distinguished, which, by treatment with caustic potassa, yield homologous volatile bases:—

Normal narcotina, $C_{21}H_{21}NO_7$, yields ammonia.
Methylic narcotina, $C_{22}H_{23}NO_7$, yields methylamina.
Ethylic narcotina, $C_{23}H_{25}NO_7$, yields ethylamina.
Propylic narcotina, $C_{24}H_{27}NO_7$, yields propylamina.

Narcotina, by the influence of dilute H_2SO_4 and hyperoxide of manganese, is decomposed into water, opianic acid and the following stronger alkaloid.

Cotarnina.—Crystallizing in colorless prisms, easily soluble in boiling water, alcohol, ether, and ammonia, intensely bitter, alkaline reaction. The various homologous kinds of narcotina appear to furnish also homologous kinds of cotarnina:—

Normal cotarnina, $C_{12}H_{13}NO_3$. Methylic cotarnina, $C_{13}H_{15}NO_3$.
Ethylic cotarnina, $C_{14}H_{17}NO_3$. Propylic cotarnina, $C_{15}H_{19}NO_3$.

Codeia, $C_{18}H_{21}NO_3$ (equiv. 299), crystallizes in octohedral or prismatic crystals, with two equivalents of water, soluble in alcohol, ether, and in boiling water. It is slowly precipitated by ammonia, more rapidly by potassa, and is insoluble in fixed alkalies; it is colored yellow by concentrated nitric acid. Its salts are neutral, and have a bitter taste.

In doses from one-fifth to one-half grain, it produces a tranquillizing effect, while over two grains produce sleep, with stupefaction, and sometimes with nausea and vomiting. It has been much used of late in cases in which the salts of morphia disagree with the patient.

Thebaia, or paramorphia, $C_{19}H_{21}NO_3$ (equiv. 307), is contained in the precipitate produced by lime in an infusion of opium, from which it is obtained by extracting with muriatic acid, precipitating by ammonia, and crystallizing from ether.

The small alkaline crystals have an acrid taste, are little soluble in water, and colored red by sulphuric acid. The solution of its muriate leaves a resinous mass on evaporation. It is very poisonous.

Narceina, $C_{23}H_{29}NO_9$ (equiv. 461), occurs in very thin prisms, of a bitter and sharp taste, which are fusible at 197.5°, easily soluble in hot water and in alkaline solutions, but insoluble in ether and in concentrated solution of potassa. Its combinations with mineral acids are obtained with some difficulty; they are rendered blue by a little water, colorless by more water, blue again by fused chloride of calcium.

Its medicinal effects appear to be directed to the lower portion of the spine, since it decreases the mobility and sensibility of the lower extremities.

Opiania, $C_{21}H_{21}NO_7$ (equiv. 397), is contained in Egyptian opium; it crystallizes in long prisms which are insoluble in water, but dissolves in much hot alcohol. It has an alkaline reaction, a bitter taste, and is narcotic of the strength and manner of morphia. Nitric acid renders it yellow; if added to its solution in sulphuric acid, blood-red changing to light yellow.

Papaverina, $C_{20}H_{21}NO_4$ (equiv. 337), is an alkaloid in small acicular crystals, which turn blue with sulphuric acid; with muriatic acid in excess it forms very insoluble colorless prisms, which possess a high refractive power. It is insoluble in water, little soluble in alcohol and ether. It appears to be devoid of narcotic properties.

Phormia, or Pseudomorphia, $C_{27}H_9NO_7$ (equiv. 457), has been obtained by Pelletier only from a few lots of opium; after precipitating the sulphate of morphia by ammonia, and evaporating the mother-liquid, white micaceous scales are separated, containing about one-tenth per cent. of H_2SO_4; after removing the acid by ammonia, the crystals of phormia are not so lustrous as before, and less soluble in water, it is insoluble in absolute alcohol and ether, somewhat soluble in alcohol of .833 sp. gr., soluble in caustic soda and potassa. Nitric acid colors it red, oxidizing it ultimately to

oxalic acid. Neutral salts of sesquioxide of iron render it blue; the blue solution, in sesquichloride of iron, turns green on boiling; on the addition of ammonia, wine-red. It is not poisonous.

Opina or Porphyroxin.—Powdered opium is exhausted by cold ether, then by a weak solution of carbonate of potassium, again by ether; codeia, thebaia, and opina are dissolved; the extract of the last tincture is dissolved in muriatic acid, precipitated by ammonia (codeia remains in solution), the precipitate is treated with alcohol, which, leaving thebaia behind, dissolves opina. It crystallizes in fine needles, soluble in alcohol, ether, and dilute acids; solutions in mineral acids turn purplish-red on boiling.

Metamorphia.—In preparing morphia by Mohr's process, Scharf obtained a new alkaloid to which the above name was given by Wittstein. It crystallizes in hard prisms, which dissolve in about 6000 parts of cold and 70 parts of hot water, in 9 parts of boiling and 330 parts of cold strong alcohol; the last solution has a sharp bitter taste and a slight alkaline reaction. It is insoluble in ether, soluble in potassa, less in ammonia. Nitric acid colors it orange-red and dissolves it yellow; concentrated iodic acid gradually liberates iodine. Its salts are not precipitated by ammonia. Its action upon the animal economy appears to be closely allied to that of morphia.

Apomorphia.—This was first prepared by Arppe in 1845, but attention has lately been called to it in England by Matthieson and Wright, who prepared it by means of hydrochloric acid. It is a derivative of morphia, having the elements of one equivalent of water taken from it; its emetic power, being free from the most objectionable properties of the ordinary emetics, renders it valuable, while its peculiar properties fit it for subcutaneous injection. (*Am. Jour. of Pharm.*, vol. xliv. 322.)

The following is Merck's TEST FOR OPIUM:—

The concentrated solution is treated with caustic potassa, and skaken with ether; a strip of paper, having been dipped several times in the ethereal solution, is moistened with muriatic acid, and exposed to the vapors of boiling water; on account of the opina, the paper will acquire a red color if opium is present in the liquid. (*See also* Meconic Acid.)

Sanguinarina, or Chelerythrina. $C_{37}H_{64}N_4O_8$. (Equiv. 784.)

This alkaloid is derived from the roots of Sanguinaria Canadensis, Chelidonium majus, and Glaucium luteum, by exhausting them with weak sulphuric acid, precipitating by ammonia, dissolving it out by ether, and precipitating by sulphuric acid; the sulphate is decomposed by ammonia. It is a white, pearly substance, of an acrid taste, very soluble in alcohol, also soluble in ether, in fixed and volatile oils. With acids it forms soluble salts, which are remarkable for their beautiful red, crimson, and scarlet colors. From this it is inferred that a native salt of this alkaloid is the occasion of the brilliant color of the fresh juice of the plant. The alkaloid

is poisonous in large doses, but its salts are used in medicine and found to be very useful in doses of fractions of a grain in expectorant remedies.

Chelidina, $C_{40}H_{20}N_3O_3$.—The precipitate, as above, which is insoluble in ether, is exhausted with dilute sulphuric acid, the solution precipitated by ammonia, and the precipitate crystallized from acetic acid, when colorless flat crystals remain, which are free of acetic acid, have a bitter taste, and dissolve in alcohol, fixed and volatile oils.

It forms colorless, acidulous salts, of a purely bitter taste, which are not poisonous.

Puccina is the name given by Dr. Gibb to an alkaloid discovered by Prof. E. S. Wayne in the ethereal solution of sanguinarina; its sulphate remains dissolved in ether after sanguinarina is precipitated; its salts are of a deep red color. (See *Am. Journ. of Pharm.*, vol. xxviii. p. 520.)

Glaucina is prepared from the juice of the herb of Glaucium luteum, by precipitating it with acetate of lead, treating the filtrate with sulphuretted hydrogen, precipitating it with tannin, decomposing the precipitate by lime, and crystallizing from alcohol. In the horn-poppy it is combined with fumaric acid.

It is in pearly scales, of a burning, acrid taste, readily soluble in boiling water, ether, and alcohol. It assumes a red color in the light, dissolves in warm sulphuric acid, with a greenish-blue color, rendered reddish by dilution, and precipitated by ammonia, with a blue color. Its salts are acrid.

Picroglaucina, *gaucina*, is prepared from the root in a similar way. It is in white crystalline scales, of a bitter, nauseous taste, soluble in water, alcohol, and ether, and colored deep green by sulphuric acid. The salts are crystallizable, and of a bitter, nauseous taste.

Corydalina, $C_{20}H_{26}NO_7$.—The juice of the root is precipitated by acetate of lead, dilute sulphuric acid and ammonia; the last precipitate yields the alkaloid to alcohol. It has also been obtained from the American species, though by a different process.

Soft grayish-white lumps or powder, colorless prisms or scales, without odor, nearly tasteless, insoluble in water, soluble in ether, alcohol, and alkalies; of an alkaline reaction, the solutions are greenish-yellow; it melts in boiling water, and is colored greenish-yellow in the light; the salts are soluble, very bitter, somewhat crystallizable; nitric acid, even in dilute solutions, colors corydalina red or blood-red, destroying it at the same time. (See *Am. Journ. of Pharm.*, vol. xxvii. p. 205.)

Fumarina is similar to the foregoing, but soluble in water and insoluble in ether; it precipitates solution of gelatine.

Violia.—The alcoholic extract is treated with ether, then boiled with sulphuric acid and water, precipitated with oxide of lead, the precipitate treated with alcohol. Similar in its action to emetia; but differing chemically from it by rendering reddened litmus paper green, and being more soluble in water, less in alcohol, it is insoluble

in ether and fixed oils, and is precipitated from the solution of its sulphate by gallic acid. Some violets, however, contain *emetia*.

Anchietia.—In the root of Anchieta salutaris, which is successfully used in Brazil, for the treatment of various skin diseases.

The bark of the root is mashed and allowed to ferment, extracted with muriatic acid and water, evaporated and precipitated by ammonia; by treatment with animal charcoal and repeated crystallization from alcoholic solution it is obtained pure. Yield about .42 per cent.

Straw-yellow needles, insoluble in ether and water, easily soluble in alcohol, no smell, taste sharp, nauseous; nitric acid colors it orange-yellow to chrome-yellow; sulphuric acid violet to blackish.

The salts are soluble, crystallizable; the muriate is colorless, crystallizing from hot water in star-like needles, after which it is insoluble in water.

Theobromina, $C_7H_8N_4O_2$.—It is prepared from the chocolate nut, by a process similar to that for obtaining caffeina. It dissolves with difficulty in boiling water, alcohol, and ether; boiling solution of caustic baryta dissolves it, and it separates again on cooling. It has a slightly bitter taste, is unalterable in contact with the air, is rendered brown on exposure to a heat of 480°, and sublimes at between 554° and 563°, leaving but little charcoal.

Its salts resemble those of caffeina. The tannate is soluble in an excess of tannic acid, in alcohol, and boiling water. With chlorine it is converted into methylamina. Prof. Strecker has found that by heating in a sealed tube Theobrominia + AgO with C_2H_3I (iodide of methyle) the resulting products are AgI + HO + Caffeina.

Caffeina, *Theina*, *Guaranina*, *Psoralein*, $C_8H_{10}N_4O_2 + 2H_2O$.—It is prepared from the hot infusion of tea or coffee by precipitating the tannic acid with subacetate of lead, boiling the mixture, filtering, removing the excess of lead by hydrosulphuric or sulphuric acid, evaporating the clear liquor and recrystallizing the product.

A. Vogel, jr.'s, method is as follows: Powdered coffee is extracted by commercial benzol, this is distilled off, leaves an oil and caffeina behind; the oil is removed by a little ether or by water, from which latter liquid the alkaloid crystallizes on cooling.

Coffee contains about ¼ per cent., tea (gunpowder) 1 to 4 per cent., Ilex Paraguayensis (Psoralea glandulosa), .13 per cent. of *caffeina*. Black tea contains more caffeina than green tea.

It crystallizes in needles, losing 2 eq. water of crystallization at 302° F.; it melts at 352° and sublimes at 725° without decomposition; it is soluble in alcohol, ether, chloroform, and hot water, cold water dissolves but little. If boiled with nitric acid, the yellow liquid assumes a purple color.

Its salts and double salts are well defined and crystallizable, some are decomposed by water. It produces a crystalline precipitate with nitrate of silver. Tannate of caffeina is obtained as a white precipitate, soluble in boiling water.

When caffeina is distilled with caustic baryta, the distillate contains ammonia and methylamina, and there remains in the retort

a new base *caffeidina*, $C_7H_{12}N_4O_2$, which is not precipitated by solution of ammonia or potassa, but is separated in oily drops by solid KO.

Caffeina is not an alimentary, but tonic, and in large doses a poisonous substance, producing death in various animals, by palsying the nervous system. (*Dr. Stuhlmann.*) It seems to act chiefly on the ganglionic system of nerves, and but slightly on the brain. L. Thompson has used it in doses of from 1 to 5 grains in the low stages of typhoid fevers with marked success; he also recommends it in hemicrania, neuralgia, and relapsing fever. Its solution in citric acid has been used with considerable success in the treatment of sick-headache. (*See* Extemporaneous Pharmacy.) This solution is frequently regarded as the solution of a citrate, the existence of which, however, is denied by Hager. The arseniate of caffeina has been used by Dr. Gastriel, of Cairo, Egypt, as a substitute for quinia in intermittents. (*Am. M. Monthly*, xvii. 267.)

Harmalina, $C_{13}H_{14}N_2O$.—The seeds of Peganum harmala (Ruta sylvestris), a plant of Southern Russia, are used there as a dye, and are said to be inebriating and soporific.

The neutralized infusion with acidulated water is saturated with table salt, in which solution the chlorides are insoluble; the purified salts are precipitated by excess of ammonia, when harmina crystallizes first in needles, afterwards harmalina in scales. Colorless scales or octohedrons, nearly tasteless, with difficulty soluble in water and ether.

The salts are of a sulphur-yellow color, not dyeing; of a purely bitter taste; precipitated by excess of acids or inorganic salts. By digestion with alcohol another alkaloid—

Porphyrharmina, harmala of Goebel, is obtained, of a red color, yielding red salts and dyeing.

Harmina, $C_{13}H_{12}N_2O$, is a product of oxidation of harmalina; it crystallizes in colorless prisms; its salts are colorless, but otherwise resemble those of harmalina. Harmina and harmalina are splendid red dyes, if previously converted into porphyrharmina.

Jamaicina is obtained from the cabbage-tree bark, Geoffroya Jamaicensis, also called Andira inermis.

The aqueous infusion is precipitated by basic acetate of lead, treated with sulphuretted hydrogen, and evaporated. It crystallizes in yellow quadrangular tables, bitter, soluble in water, little in alcohol, melting below the boiling point of water. The salts are yellow, bitter, some crystallizable; in small doses they produce restlessness, in larger purging. It is said to be vermifuge.

Surinamina.—From the bark of Andira retusa (Geoffroya Surinamensis), is prepared similarly to the above. It crystallizes in fine white microscopic needles, without taste or smell, nearly insoluble in cold water and ether, soluble in boiling alcohol and boiling water.

Baptisina.—The root of Baptisia tinctoria contains an alkaloid which has not been isolated, unless the crystalline principle of B. L. Smedley (*Am. Journ. Pharm.*, 1862, 310) is the pure alkaloid.

Cynapia is a scarcely known alkaloid, obtained by Ficinus from fool's parsley. (*See* Syllabus.) It crystallizes in rhombic prisms, which are soluble in water and alcohol, insoluble in ether, and have an alkaline reaction. The sulphate is crystallizable.

Trianospermia.—From the root of the Brazilian tayuya de pimenta comari, Peckolt separated this alkaloid, which is probably identical with Herberger's *tayuyina.* It crystallizes in colorless needles, is inodorous, of a biting taste, insoluble in ether, soluble in alcohol and water, has an alkaline reaction, and furnishes with sulphuric acid a crystallizable salt. It appears to be purgative.

Atherospermia, $C_{30}H_{40}NO_5$, was discovered by Zeyer in an Australian drug. (*Am. Journ. Pharm.*, 1862, 165.) It is a grayish-white powder, of a bitter taste, changing to yellowish in the sunlight. When carefully heated it gives off the odor of putrid meat and afterwards of herrings; it probably evolves propylamina. It is nearly insoluble in water; dissolves in 1000 parts of cold and 100 p. boiling ether, in 32 p. cold and 2 p. boiling stronger alcohol, in chloroform, bisulphide of carbon, volatile and fixed oils; concentrated nitric acid produces a brown-yellow color; sulphuric acid and chromate of potassium yield slowly a green color of Cr_2O_3; from iodic acid it liberates iodine.

Cocaina, $C_{17}H_{21}NO_4$ is obtained from the leaves of Erythroxylon coca by exhausting them with acidulated alcohol, treating with milk of lime, neutralizing the filtrate with sulphuric acid, evaporating, diluting with water, filtering from the resin, precipitating by carbonate of sodium and exhausting the alkaloid by ether, the last traces of coloring matter can only be removed by washing with alcohol.

It crystallizes from its alcoholic solution in colorless prisms; soluble in 704 parts of cold water, in alcohol and ether. The solutions are alkaline to test paper; bitterish; promote the flow of saliva and produce a feeling of numbness upon the tongue.

Its salts crystallize with some difficulty, and show no striking reactions with tests, or peculiar coloration with oxidizing agents. Its precipitate with iodohydrargyrate of potassium (Mayer's test) dissolves in muriatic acid, in which behavior it differs from other alkaloids.

Heated with muriatic acid it splits into benzoic acid and a new base *ecgonina*, $C_9H_{15}NO_3+H_2O$, which is soluble in water.

For further accounts see the papers of Dr. A. Niemann (*Am. Journ. Pharm.*, 1861, 122), of J. M. Maisch (*ibid.*, 496), and of Lossen (*ibid.*, 1862, 406).

The Cinchona Alkaloids and their Salts.

Quinia. $C_{20}H_{22}N_2O_2+H_2O$. (Equiv. 324.)

This alkaloid is prepared from various species of cinchona bark, which contain it in combination with kinic acid and the astringent principle called cincho-tannic acid. These combinations being only partially soluble in water, resort is had to an acid which liberates

the alkaloid in a soluble form. That used in our officinal process for preparing the sulphate of quinia is muriatic, which is mixed with water in which the powdered bark is boiled. The very soluble muriate of quinia contained in this decoction is decomposed, giving up its acid to lime, while the quinia is liberated, and, being insoluble, is precipitated with the excess of lime added, the water retaining the chloride of calcium resulting from the reaction, and most of the impurities, in solution. The precipitated quinia and excess of lime being now digested in alcohol, the former is dissolved, and the impure quinia is obtained by evaporating this alcoholic solution. The remaining part of the process consists in converting this into the officinal sulphate, at the same time rendering it pure. To accomplish this, the amorphous mass is dissolved in diluted sulphuric acid, and filtered through bone-black, which contains sufficient carbonate of lime to neutralize the excess of sulphuric acid, and thus facilitate the crystallization of the sulphate as the solution cools. This process requires to be repeated, with the addition of acid, if the charcoal is too alkaline, till a white and pure product is the result.

The following is the process for preparing this alkaloid without alcohol, by Herring, who substitutes in place of it, oil of turpentine or benzole:—

Powdered bark is boiled with caustic soda, to remove extractive, gum and coloring matter, exhausted with diluted sulphuric acid, evaporated at about 120°, filtered, precipitated by caustic soda, washed, redissolved in H_2SO_4, recrystallized, treated with animal charcoal, and by fractional crystallizations purified from the other alkaloid.

The soda liquor is supersaturated with muriatic acid, evaporated, filtered, treated with hydrate of lime, from which precipitate the alkaloids may be extracted by oil of turpentine or benzole. On adding diluted H_2SO_4, a solution of the alkaloid is obtained to be purified as above.

Quinia occurs in silky needles, or in a crystalline powder, fusible at 194° to an electrical mass, soluble in about 400 parts of water, 60 parts ether, 2 parts alcohol or chloroform, 24 parts of olive oil, also in alkalies, carbonate of ammonia, chloride of calcium, etc. Its solution in concentrated nitric acid turns yellow by heat, the solution in sulphuric acid is colored only at a high temperature.

Its salts are mostly crystallizable; their solutions show a blue fluorescence, and on the addition of fresh chlorine water and a little ammonia, are colored violet, by an excess of NH_3 emerald-green; too much chlorine causes a brown color. A solution of quinia in diluted sulphuric acid, mixed with some acetic acid and alcohol, and heated to 130°, yields, after the addition of tincture of iodine, beautiful emerald-green crystals of iodosulphate of quinia, Herapath's salt, which are nearly colorless by transmitted light. The solution of its salts is precipitated by alkalies, their carbonates and bicarbonate; but if they had been previously sufficiently acidulated

with tartaric acid, bicarbonate of sodium produces no precipitate. If their solution is treated first with chlorine water, free from hydrochloric acid, and subsequently with finely-powdered ferrocyanide of potassium, a red coloration is produced, while potassa causes a yellow color. Quinia salts are precipitated by ferrocyanide of potassium, the precipitate is dissolved on boiling and by an excess of the precipitant. (Differences from cinchonia.)

Quiniæ Sulphas, U. S. P.—Of the salts, the neutral sulphate (formerly called disulphate) is officinal and mostly employed. Its mode of preparation has been given above. It is in feathery white crystals, much interlaced; of its eight equivalents of water, six are given off by exposure to dry air, while the remaining two are driven off at 248°. It dissolves in 740 parts of cold and 30 parts boiling water, in 60 parts of alcohol, but scarcely in ether. The addition of a mineral or of certain organic acids renders it easily soluble. (*See* above page 475.)

The salts of quinia are all used as tonics; the sulphate, especially, is a well-known antiperiodic and febrifuge; it is said to produce abortion when given during pregnancy. The dose varies from one to twenty grains. It is given in power, pill, mixture, and solution. (*See* Extemporaneous Pharmacy.)

By heating together sulphate of quinia, solution of chlorinated lime, muriatic acid, and ammonia water, a green resinous mass is obtained, which has been called *dalleochine* or *quinine green.* Mineral acids dissolve it with a brown, acetic acid with a blue color, the green being restored on neutralization. Its alcoholic solution, diluted with water, dyes silk, woollen, and cotton, the latter after the application of albumen as mordant.

Quiniæ Valerianas, U. S. P.—Valerianate of quinia was made officinal in 1860. It is obtained by dissolving freshly-precipitated quinia in diluted valerianic acid, heated to 180° F., and crystallizing by cooling; the mother-liquors are evaporated below 120°. It combines the tonic properties of quinia with the antispasmodic effects of the valerianates.

It is colorless, or white; crystallizes in rhomboidal tables, and has a peculiar repulsive odor and bitter taste. When heated it fuses and gives off white vapors. It dissolves in 110 p. of cold, and 40 p. of boiling water, and in 6 p. of cold and 1 part of hot alcohol, also in ether. The dose is from one to five grains.

The following unofficinal salts are occasionally prescribed:—

Quiniæ Murias.—The *Dublin Pharmacopœia* orders 437 grains of crystallized sulphate of quinia (equivalent to 382 grains of the salt dried at 212°) dissolved in 30 ounces of boiling water, to be precipitated by 123 grains of chloride of barium, and the filtrate evaporated until a pellicle forms. Another process is to decompose 1 part of the sulphate in alcoholic solution by 3 parts of chloride of sodium. It crystallizes with $3H_2O$ in needles of a pearly lustre, more soluble than the sulphate. Baryta is detected by sulphuric acid, sulphate of quinia by chloride of barium.

Quiniæ hypophosphis.—Introduced to notice by Prof. J. Lawrence

Smith, is made with facility by dissolving one ounce sulphate of quinia in water by the aid of diluted sulphuric acid, then precipitating the alkaloid with ammonia, washing, digesting the quinia in excess, in hypophosphorous acid with heat; after filtering, it is evaporated spontaneously till it crystallizes. It may also be made by double decomposition between hypophosphite of baryta and sulphate of quinia. It is in elegant tufts of feathery crystals, soft to the touch, soluble in 60 parts of water, and more so in hot water. It loses water at 300°, melts, and turns brown. DOSE, one to five grains.

Quiniæ iodosulphas, Herapath's salt, the preparation of which has been noticed among the tests for quinia, has been used in hæmoptysis, tuberculosis, scrofula, etc., in doses of ½ to 3 grains, three or four times a day. (See *Am. Drug. Circ.*, iv. 285.)

Quiniæ Hydriodas.—5 parts of effloresced sulphate of quinia dissolved in alcohol and decomposed by an alcoholic solution of 3 parts of iodide of potassium, precipitates sulphate of potassium, and yields, on cooling and evaporating, hydriodate of quinia in fine crystalline needles.

Quiniæ antimonias is precipitated by double decomposition of antimoniate of potassium and sulphate of quinia, and crystallized from hot water or alcohol. It has been administered in periodical diseases in doses of from six to ten grains during apyrexia, and it is stated to be rarely necessary to give it a second time.

Quiniæ Arsenis.—Quinia is precipitated from 100 parts of its sulphate, dissolved in 600 parts alcohol, and boiled with 14 parts arsenious acid, the filtrate, on cooling, separates needles of this poisonous salt. It may be given with caution in doses from one-quarter to one-half grain several times a day.

Sulphate of quinia, iron, and magnesia, as proposed by Dr. Fergus, contains 5 parts of the first, 15 of the second, and 80 of the third sulphate, it being merely an intimate mixture of the three. It is claimed for this preparation that the adjuvant property of both iron and quinia are remarkably heightened, and that in solution the iron is not oxidized. (?)

Quiniæ lactas is obtained by saturating lactic acid with quinia, or by double decomposition of the baryta salt of the former with the sulphate of the latter, and crystallizes in soluble needles.

Quiniæ tartras is crystallized in needles from the hot solution of quinia in tartaric acid.

Quiniæ citras is separated in needles from the hot mixture of citrate of sodium added to sulphate of quinia until an acid reaction is shown to test paper. (*See* Citrate of Quinia and Iron.)

Quiniæ Acetas.—Seventeen parts of the effloresced sulphate of quinia are dissolved in boiling water and mixed with six parts of crystallized acetate of sodium; acetate of quinia crystallizes in white feathery needles, nearly insoluble in cold water. (See remarks in *Am. Journ. Pharm.*, xxx. 385.)

Quiniæ hydrobromas.—Two hydrobromates are known; the neutral which is very soluble in water and alcohol, and has an alkaline reac-

tion, and the basic, which is much less soluble, and is alkaline in its reaction. 10 parts of basic sulphate of quinia and 50 parts of alcohol (85°) are heated together in a small flask, 8 parts of bromide of potassium dissolved in 20 parts of water are mixed with 10 parts of diluted sulph. acid (1 per cent.) and added to the solution of quinia, which is then brought to the boiling point; after a few minutes the sulphate of potassium is separated by filtration and washed with hot alcohol. The filtrate and the washings are evaporated and allowed to crystallize. The salt is pearly white and opaque, and contains traces of sulphuric acid. The basic hydrobromate may be prepared in the same manner, using five parts of bromide in place of ten.

Quiniæ Uras.—One part freshly precipitated quinia, one and a half of uric acid, and one hundred and fifty parts of water are to be boiled together in a glass vessel, filtered while hot, the contents of the filter treated with boiling water, and the filtrate mixed and set by in the cold to crystallize. The salt forms as a white granular mass, the mother-liquor yielding a portion by evaporation. When dry it is a white powder, with a feeble lustre, under a microscope showing the form of truncated crystals; soluble in 855 parts of cold water, 1580 parts of alcohol, sp. gr. 823, or 21.25 parts of ether; it consists of quinia 59.34, uric acid 27.47, water 13.19.

Quiniæ Tannas.—Tannic acid precipitates tannate of quinia from all solutions which have not been too much acidulated; it has little taste on account of its sparing solubility in neutral liquids.

Quiniæ gallas is obtained by double decomposition between a hot solution of sulphate of quinia and gallate of potassium. It is in crystalline granules, or a white powder, almost insoluble in water, soluble in alcohol and dilute acids.

Quiniæ Kinas.—To obtain this natural salt directly from the bark, the following process is given by Henry and Plisson. The extract is dissolved in 3 parts of water, nearly neutralized by carbonate of calcium, then cautiously neutralized by hydrated oxide of lead; from the filtrate the lead is removed by sulphuretted hydrogen, after which the evaporated liquid is treated with alcohol of .842, the alcohol distilled off and the residue repeatedly treated with water and alcohol until nothing is separated by these liquids. It is obtained in white crystalline warts, soluble in 4 parts of water, and 8 parts of alcohol.

Quiniæ Hydroferrocyanas.—1 part sulphate of quinia, $1\frac{1}{2}$ parts ferrocyanide of potassium, and 7 parts of boiling water yield the salt on cooling, which is to be recrystallized from alcohol. It appears in greenish-yellow needles, which are insoluble in water. Pelouze asserts it to be quinia mixed with some Prussian blue. Dollfuss found it to be $C_{40}H_{24}N_2O_4 + 2(FeCy + 2HCy) + 6Aq$.

Quiniæ Sulphocarbolas.—A formula for this salt is published in *Amer. Journ. Pharm.*, xlii. 506.

Quinidia, $C_{20}H_{24}N_2O_2 + 2H_2O$. (Equiv. 360.)

This name is now generally applied to an alkaloid which is isomeric with quinia, but differs from it in turning polarized light

to the right. It occurs, in company with the other alkaloids, in many cinchona barks, particularly those imported from New Grenada.

It is obtained from its sulphate by decomposition with ammonia, and crystallizes in shining colorless efflorescing crystals, which are readily reduced to a white powder; they melt without decomposition, and, on cooling, concrete into a grayish-white crystalline mass. When ignited, they burn with the odor of kinole and the volatile oil of bitter almonds; they have a less intensely bitter taste than quinia. This alkaloid dissolves in 1500 p. cold and 750 parts boiling water, in 3 parts of boiling alcohol and 90 of ether, and its solution turns to a green color like quinia when successively treated with chlorine water and ammonia; a solution of either alkaloid even in 700,000 parts of water, according to Herapath, shows a dispersion of light with a bluish milky coloration. Quinidia, treated with tincture of iodine under the same circumstances as quinia, yields crystals which appear garnet-red by transmitted light, and bluish-red in reflected light. Quinidia is the only cinchona alkaloid yielding, with the solution of an iodide, a nearly insoluble precipitate of hydriodate of quinidia.

Quinidiæ sulphas is more soluble than sulphate of quinia, and remains in the mother-liquor after the quinia salt has been crystallized. When the cheaper barks above referred to are manipulated with, this salt is an important product; it is largely produced, and, by some, used as a substitute for quinia. As generally found in commerce, it contains cinchonidia, and comes in long, shining white crystals, interlaced, and resembling those of sulphate of quinia. It is soluble in 130 parts of cold water, freely soluble in alcohol, and almost insoluble in ether. It contains six equivalents of water of crystallization.

Cinchonia. $C_{20}H_{24}N_2O$. (Equiv. 308.)

This is a cinchona alkaloid usually accompanying quinia. Huanuco bark contains almost exclusively cinchonia, which, when first isolated from this bark, was called huanucina, under the supposition of its being a distinct alkaloid.

It may be obtained from this bark by a process similar to that for the preparation of quinia. It is in white needles, insoluble in alkalies, ether, and cold water, but soluble in 13 parts of boiling alcohol; chloroform dissolves 4.3; olive oil, 1 per cent. of cinchonia. It is less bitter than quinia and quinidia, fuses at 330° to an amorphous mass, and at a higher temperature partly sublimes without decomposition; polarized light is deviated to the right.

Its salts are generally more soluble than the corresponding salts of quinia; they are precipitated by the caustic alkalies and their carbonates; and in not too diluted solutions the bicarbonates likewise cause a precipitate after the previous addition of tartaric acid. Under similar circumstances cinchonia does not produce the reaction of quinia with chlorine and ferrocyanide of potassium. The

precipitate of ferrocyanide of potassium in cinchonia salts is insoluble in an excess of the precipitant, but crystallizes from its hot solution; its composition corresponds with the quinia salt. The cinchonia sulphate, if treated with iodine similarly to sulphate of quinia, yields a brick-red deposit.

Cinchoniæ Sulphas, U. S. P.—If cinchonia occurs in barks with quinia and quinidia, this salt remains behind in the mother-liquor after the crystallization of the other sulphates. The *Pharmacopœia* of 1860 directs to precipitate this mother-liquor by solution of soda, until it becomes alkaline; collect on a filter, wash it with water, and dry it. Then wash it with successive small portions of alcohol to remove other alkaloids which may be present. Mix the residue with eight times its weight of water, and having heated the mixture, add gradually diluted sulphuric acid until it is saturated and becomes clear. Then boil the liquid with animal charcoal, filter it while hot, and set it aside to crystallize. Lastly, drain the crystals and dry them on bibulous paper. By evaporating the mother-liquid more crystals may be obtained.

Sulphate of cinchonia crystallizes in white, shining, short oblique prisms with dihedral summits. It melts at 212°, loses its water of crystallization at a somewhat higher temperature, and is dissipated at a red heat. It dissolves in 54 parts of cold and much less boiling water, in seven parts of alcohol, and very sparingly in ether. Its aqueous solution gives with $AuCl_3$ a yellow precipitate, and with CaCl a white one. Ammonia added to its solution in chlorine water causes a white precipitate. If the salt be rubbed with water of ammonia and then treated with ether, the cinchonia separated by the former will not be dissolved by the latter.

On the addition of sulphuric acid it passes into the very soluble acid sulphate.

The other salts of cinchonia may be prepared like the corresponding quinia salts; the following have been occasionally used:—

Cinchoniæ murias is in silky prisms, easily soluble in water and alcohol. This salt has been fraudulently sold for sulphate of quinia, which it much resembles in appearance. (See *Am. Journ. Pharm.*, 43, 92.)

Cinchoniæ hydriodas crystallizes in needles.

Cinchoniæ tannas is a yellowish powder, soluble in alcohol.

Cinchoniæ acetas.—If acetic acid is saturated with cinchonia, on evaporation granular or scaly crystals of the acetate are left, which are easily soluble in water.

Cinchonidia. $C_{20}H_{24}N_2O$. (Equiv. 308.)

Cinchonidia often constitutes the greatest part of commercial quinidia; as it contains no water of crystallization, it is not efflorescent in the air.

Its principal peculiarities are: It is sparingly soluble in ether and water, dissolves in 12 parts cold alcohol, deviates polarized light to the left, and gives no reaction with chlorine water and

ammonia. By Dr. Herapath's test, viz., treating with iodine like quinia, the resulting idosulphate of cinchonidia is so similar in appearance to the corresponding quinia salt, that it can only be distinguished from it by a little difference in the tint caused by transmitted light.

Its salts are freely soluble in water and alcohol, not in ether.

The base discovered by Wittstein, and called by him cinchonidia, is, according to de Vry, a mixture of various alkaloids, but principally of cinchonia and Pasteur's cinchonidia; and the *huanokina* of Erdmann, according to the same authority, is cinchonia containing some quinidia.

Betacinchonia, $C_{20}H_{24}N_2O$, was announced by W. Schwabe as a constituent of some chinoidine. It crystallizes in quadrangular prisms, is anhydrous, fuses at 302° F., is scarcely soluble in hot water, soluble in 173 parts of cold and 43 of boiling alcohol, in 378 parts of ether and 268 parts of chloroform, also readily in volatile and fatty oils. Its alcoholic solution deviates polarized light to the right. It is not affected by chlorine water and ammonia.

Its salts are all neutral though crystallizing from an acid solution; the precipitate by alkalies is somewhat soluble in excess; after acidulating with tartaric acid, bicarbonate of sodium produces no precipitate. Iodosulphate is analogous to herapathite. (See *Am. Journ. Pharm.*, 1861, p. 419.)

The reactions as stated prove this alkaloid to be closely allied to the two preceding ones, and it is not impossible that it may have been formed from one of them by some chemical influence. O. Hesse, however, asserts that it is nothing but cinchonia. (*Am. Journ. Pharm.*, 1863, p. 54.)

Paytine is the name given by Hesse to a crystalline alkaloid discovered by him in a false cinchona, resembling the quina blanca of Mutis. The figures obtained by its analysis lead to the formula $C_{20}H_{24}N_2O$. It forms a variety of salts with acids, although its alcoholic solution reddens blue litmus paper. Though bitter, it does not seem to produce physiological effects. Its color reactions are numerous and remarkable.

Oxycinchonia, $C_{20}H_{24}N_2O_2$, has been obtained by oxidation from cinchonia by Strecker in the endeavor to prepare quinia artificially. Though of the same composition it lacks its most prominent properties. (Ibid. 58.)

Quinicia and Cinchonicia.—The acid sulphates of quinia or cinchonia, if heated for three or four hours to about 250° or 266°, are converted into alkaloids, isomeric with the original bases, the former into quinicia, and the latter into cinchonicia, and but very little coloring matter; the neutral salts suffer partial decomposition at that temperature after melting. Both alkaloids are nearly insoluble in water, soluble in alcohol, easily combined with carbonic acid, displace ammonia from its salts, and deviate the polarized light a little to the right. The optical behavior of the different alkaloids, therefore, is as follows:—

Quinia, considerably to left.	Cinchonia, considerably to right.
Quinidia, " right.	Cinchonidia, " left.
Quinicia, feebly to the right.	Cinchonicia, feebly to the right.

Howard's recently discovered alkaloid of cinchona, originally described in the *Journal of the Chemical Society*, 2d series, ix. 61, has not been obtained in crystals, but appears in the form of a yellowish oil, very soluble in alcohol and ether. It is a strong base, forming neutral and very soluble crystallizable salts, not as bitter as those of quinia; the oxalate, which is the best known, has a greenish-yellow hue.

Chinoidina or Quinoidina (*Chinoidine*).—Is a product of alteration of the cinchona alkaloids. Drying of the barks, or exposure of solution of alkaloids to the sun, and the influence of a high temperature appear to favor this alteration. It is prepared by precipitating the mother-liquor, from which the sulphates of the other alkaloids have been crystallized, by carbonate of soda, and extracting with alcohol.

It is a reddish-brown, resin-like mass, entering into combination with acids like the unaltered alkaloids. The salts are resinous, uncrystallizable, very bitter. It is isomeric with quinia, and has, therefore, been also called amorphous quinia. Pasteur supposes it to be uncrystallizable quinicia and cinchonicia. From the commercial article the four cinchona alkaloids, quinia excepted, have at various times been prepared.

It has strong febrifuge properties, and is very efficient in doses double those of the sulphate of quinia, either in pills or dissolved with a little sulphuric acid. It may be considered pure if it is entirely soluble in alcohol, and in diluted sulphuric acid.

Precipitated extract of bark is the same preparation as the above. It differs from the extractum calisayacum, referred to in the chapter on Extracts by not containing the crystallizable alkaloids.

GENERAL REMARKS ON THE CINCHONA ALKALOIDS.

Of the remarkable principles above described as existing in cinchona barks, cinchonia was the first discovered, having been isolated in an impure state as early as 1803, and fully described as an alkaloid by Pelletier and Caventou in 1820. Quinia was discovered soon after by the same chemists. Not until 1833 was the existence of quinidia announced. In that year, Henry and Delondre announced its discovery, but afterwards abandoned the idea of its being a distinct principle; so that no further attention was bestowed upon it until, about the year 1844, the celebrated German chemist, Winkler, investigated its properties, and conferred upon it the name quinidine, which, to correspond with our nomenclature, is changed to quinidia. Pasteur has since proved that quinidia as it occurs in commerce is generally composed chiefly of another alkaloid to which he gave the name cinchonidia; he likewise discovered the artificial isomeric alkaloids quinicia and cinchonicia.

On pages 501 and 502 will be found an account of other alkaloids,

discovered in particular barks, and most of them not fully investigated.

The former scarcity and high price of sulphate of quinia, occasioned in part by the restrictions placed upon the trade in genuine Calisaya bark by the Bolivian government, had the effect to direct the attention of physicians to other and similar remedial agents; but, notwithstanding the frequent announcement of favorable results from the trial of such, there seems a general disposition to withhold confidence from any but the products of that remarkable family of South American trees whose history has been so long connected with the cure of periodical diseases. The introduction into commerce of large quantities of cheap cinchona barks from new sources, has been another result of the long-continued scarcity of the older and officinal kinds. Notwithstanding these have been regarded by many with jealousy, and doubts have been entertained of their therapeutic value, the study of their chemical history has shown that some of them are not less rich in alkaloids than the finest monopoly barks, and experiments in regard to the therapeutic value of their characteristic alkaloids have shown a close resemblance in physiological effects to quinia itself. Some Bogota barks are now extensively employed for the manufacture of quinia, the price of which has, in consequence thereof, considerably declined; some of these barks, beside the other alkaloids, abound in quinia.

Dr. Pepper and other practitioners connected with hospital practice, have used sulphate of quinidia in the same or less doses than the quinia salt, and with equal success; and its value and efficacy are confirmed by the experience of many in private practice.

Sulphate of cinchonia, which had been generally overlooked, has been much used of late years as a substitute for sulphate of quinia; and, although some physicians assert that larger doses of it are required, and that it is more variable and less reliable in its action than the quinia salt, I am told by Dr. Conrad, the Apothecary of Pennsylvania Hospital, that in that Institution the three cinchona alkaloids are used indiscriminately and in the same doses. Through Dr. R. P. Thomas I am informed that the cinchonia salt has been used with satisfaction as a substitute for that of quinia in the Philadelphia and Northern Dispensaries, in the Western Clinical Infirmary, and Philadelphia Hospital, Blockley, where many intermittents are daily under treatment. It has also been successfully experimented with in the French hospitals as a substitute for the quinia salt, and has been lately introduced into the U. S. Army.

Quinoidine is sold at a still lower price than either of the crystallized products. I am told that the demand for it has not justified manufacturers in preparing all that is produced, for sale.

Detection of Adulterations and Impurities in Sulphate of Quinia.—The behavior of the cinchona alkaloids and their salts has been mentioned under their respective heads, and, with the aid of these tests, it is not very difficult to distinguish the alkaloids, when pure, from each other. There is more difficulty experienced in detecting

the presence of one alkaloid in another, or in finding out foreign substances sometimes fraudulently mixed with them. The following are the various tests proposed for these purposes.

1. *Zimmer's test.*—Sixty drops of ether, twenty of ammonia water, and ten grains of the sulphate, previously dissolved in fifteen drops of water and ten drops of diluted sulphuric acid, made of one part, by weight, of sulphuric acid, to five of water, are mixed in a test tube; the quinia, being soluble in the ether, will not appear, but any admixture of cinchonia, or above ten per cent. of quinidia, will separate as a layer of white powder, between the aqueous liquid and the supernatant ether. If quinidia be present, it will be dissolved by a large addition of ether, while cinchonia will not. If less than ten per cent. of quinidia is present, the mixture will be clear, but the quinidia will soon crystallize, while quinia will, after a while, gelatinize the ethereal solution.

2. *Rump's test* is said to be even more delicate than the former. Six grains of the sulphate, one-half drachm of ether, two or three drops of ammonia water, are well agitated in a test tube; pure sulphate of quinia will yield a perfectly transparent solution; if five per cent. of sulphate of quinidia is present, the solution will likewise be clear, but, after a while will become turbid; ten per cent. of quinidia will leave a portion undissolved; with less than five per cent., the solution is to be evaporated spontaneously, quinidia will then be left in crystals, but quinia as a gummy mass.

3. *Liebig's test.*—Fifteen grains of the salt are rubbed with two ounces of ammonia water, this is heated until nearly all odor of ammonia has disappeared, and agitated with two ounces of ether. If a turbidness remains on the margin of the two liquids, cinchonia is present.

The ethereal solution may, besides quinia, also contain quinidia, which, like the above, will be left in crystals on spontaneous evaporation.

4. *Kerner's test.*—Chemically pure neutral sulphate of quinia is dissolved in distilled water to saturation at a temperature of 15° C. (59° F.); 5 c.c. of this solution are precipitated and exactly redissolved by 5 c.c. of ammonia water, sp. gr. 92, and by 7 c.c. of ammonia, sp. gr. 96. For a similarly prepared solution of sulphate of quinidia and cinchonidia from 10 to 13 times this quantity of ammonia is needed to have the same effect, while the precipitate from the cinchonia salt does not redissolve. Accordingly, to test the commercial sulphate of quinia, an excess of it is treated with distilled water of 59° for one-half hour until a saturated solution is obtained; 5 cubic centimetres of the filtered solution are mixed with 7 c.c. of officinal water of ammonia (or with 5 c.c. of ammonia, sp. gr. .920); if the alkaloid is precipitated and redissolved, the quinia salt is pure; if more ammonia is required for solution, quinidia or cinchonidia is present, and if 100 c.c. ammonia do not effect a clear solution, cinchonia is present.

Since sulphate of cinchonia is the most soluble sulphate of all the cinchona alkaloids, and since the sulphates arranged according

to their solubility follow in this order: cinchonia, cinchonidia, quinidia, quinia, it is evident that if a commercial sample of sulphate of quinia is treated with an insufficient quantity of water at 59° F., the most soluble sulphates must be dissolved first, and consequently, the larger the excess of the commercial salt, the more readily will these other alkaloids be discovered in the solution by means of the ammonia water of the above standard strength. (See the very interesting paper in *Am. Journ. Pharm.*, 1862, 417–429.)

5. The presence in the sulphates of cinchona alkaloids of common adulterations may be detected as follows:—

The sulphates are entirely soluble in cold dilute sulphuric acid, and entirely dissipated by heat. *Sulphate of calcium* may be detected by its insolubility in alcohol, and by remaining, after ignition, on a piece of platina foil. *Starch* would remain insoluble in dilute acid and in alcohol, and would be recognized by the well-known iodine test. *Stearic* and *margaric acids* and *resins* would float in the acid solution, and be dissolved by ether. *Salicine*, if more than ten per cent. were present, would show, with concentrated sulphuric acid, a red color. *Phloridzin* would be detected as yielding a yellow color with the same reagent, or by the yellow, red, and blue color imparted to it by gaseous ammonia under a bell glass. *Sugar* or *mannite* would be blackened by concentrated sulphuric acid. *Oxalate of ammonium* would be detected by giving off ammoniacal vapors with caustic potassa. Solution of caustic baryta dissolves *salicine*, *phloridzin*, *gum*, *mannite*, etc., but leaves the alkaloids and sulphate of baryta; in the solution, after it has been freed from baryta by carbonic acid, these substances may be detected.

Besides the foregoing, the following alkaloids have been discovered in various barks.

Aricinia, $C_{20}H_{24}N_2O_2 2H_2O$, derived from Arica, the port from whence the bark is sent, is prepared like the other cinchona alkaloids, and crystallizes in white, transparent needles, which gradually develop a bitter, warming, sharp taste, melt between 356° and 374°, are insoluble in water, soluble in ether, alcohol, and ammonia. It is colored green by concentrated nitric acid.

The salts are crystallizable, bitter, easily soluble in water and alcohol, insoluble in ether.

Paricinia has been discovered in Para bark by Winckler.

It is a white mass, uncrystallizable, electric when rubbed to powder, slightly soluble in water, easily soluble in ether and alcohol, and is left, after evaporation, as a golden-yellow, resinous mass. Its salts are amorphous, resinous.

It appears to bear to aricina the same relation as chinoidina to quinia.

Pitayia, discovered by Peretti, is prepared from the aqueous extract, which is exhausted by alcohol, evaporated, dissolved in water, and precipitated by ammonia, washed with ether, and crystallized from boiling water.

It is in colorless prisms, volatile, not bitter. Its salts are bitter and crystallizable.

Carthagia, discovered by Gruner in Carthagena bark, crystallizes in needles, is tasteless, insoluble in water, soluble in alcohol.

Its salts are bitter, crystallizable, resembling the quinia salts, but are said to be destitute of febrifuge qualities.

Emetia. $C_{30}H_{44}N_2O_8$.

Emetia is the active principle of ipecacuanha, and is also present in the roots of several species of Viola.

The root is extracted by acidulated water, and precipitated by ammonia; to obtain it pure and white, according to Merck, it is dissolved in dilute muriatic acid, precipitated by corrosive sublimate, dissolved in alcohol, decomposed by sulphuret of barium to precipitate mercury, and sulphuric acid to precipitate baryta, diluted with water, the alcohol evaporated, and the sulphate of emetia precipitated by ammonia.

It is a white, inodorous powder, not crystalline, of a bitter taste, soluble in alcohol, sparingly so in water, nearly insoluble in ether and fixed oils, fusible at about 120° F. Its native salt existing in the root is taken up by water, wine, and diluted alcohol. It assumes a dirty-green color by sulphuric acid, is converted first into a yellow, bitter, resinous substance, afterwards into oxalic acid. In minute doses it acts as a powerful emetic; in larger doses it is poisonous. Nearly all its salts are easily soluble in water; the acid salts, according to Liebig, are crystallizable. The commercial *emetia* is very impure, and not preferable for ordinary use to the various Galenical preparations of ipecac, in which the peculiar astringent and acid principles are associated with the alkaloid.

The *emetinum impurum* of some pharmacopœias, which is the French *emetin colorée*, is obtained by exhausting the alcoholic extract of ipecacuanha with water, neutralizing with carbonate of magnesium, and evaporating the filtrate.

Arnicia.—According to the analysis of Prof. Walz (*Am. Journ. Pharm.*, 1861, 450), arnica flowers contain no alkaloid, the arnicia being a ternary glucoside, free from nitrogen.

Eupatorina is an alkaloid, almost unknown, prepared by Righini from the European water hemp. It is a white powder, of a bitter acid taste, soluble in alcohol and ether, and insoluble in water. Its sulphate crystallizes in needles.

The Alkaloids of Strychnos and their Salts.

Strychnia, U. S. P. $C_{21}H_{22}N_2O_2$. (Equiv. 334.)

The *Pharmacopœia* directs the rasped seed of nux vomica; but as their comminution in the dry state is a work of no little difficulty, it is best to first heat them with some water, or expose them to hot steam; they will become thoroughly softened, and, while still warm, may be easily bruised in a warm mortar, or between two iron cylinders; they are then treated with water acidulated with muri-

atic acid; after concentration, the muriate thus formed is decomposed by lime, which precipitates the strychnia along with the excess of lime employed, and some impurities. The alkaloid is now dissolved out from the precipitate by boiling alcohol, and deposited, on evaporating and cooling. To purify it still further, it is next converted into a sulphate, boiled with animal charcoal, and precipitated by ammonia. St. Ignatius' bean contains a large proportion of strychnia and less brucia than nux vomica, but is not so abundant and cheap.

Strychnia, as thus prepared, is a white or grayish-white powder which may be crystallized by the slow evaporation of an alcoholic solution. It is distinguished by extraordinary bitterness. It is soluble to a limited extent in water, and nearly insoluble in absolute alcohol and ether; its best solvents are 70 per cent. alcohol, and volatile oils; chloroform dissolves 20 per cent., and olive oil one per cent. of strychnia. Perfectly pure strychnia is not affected by nitric acid. The following are its most reliable tests: Rub a very little of the powder with a drop of sulphuric acid on a slab, and add a minute quantity of solution of chromate of potassium. A splendid violet color will be produced if it contain strychnia. Or thus: add a little of the powder to a few drops of sulphuric acid containing $\frac{1}{10}$ of nitric; it will form a colorless solution; but, on the addition of a little peroxide of lead, a bright blue color will be developed, which will pass rapidly into violet, then gradually into red, and ultimately to yellow. Its solution in sulphuric acid is colored red by chlorous and chloric acids, and by chlorates; a solution of the rose-colored sulphate of manganese causes a violet color, the same color is produced by ferridcyanide of potassium, and this reaction is not affected by the presence of other organic substances.

The salts which strychnia forms are mostly crystallizable and soluble. Their solutions are precipitated by fixed alkalies and their carbonates, and the precipitate is insoluble in an excess of the precipitant; the precipitate caused by ammonia dissolves, but afterwards crystallizes from an excess of it. Sulphocyanide of potassium produces a white crystalline deposit; the precipitate with gaseous chlorine is soluble in ether and alcohol. If acidulated with tartaric acid, a white precipitate occurs by bicarbonate of sodium.

Adulterations with mineral substances are discovered by the residue left after ignition or after solution in boiling alcohol. Brucia is detected by the red color on the addition of sulphuric acid.

The following salts have been occasionally used in medicine, chiefly on account of their solubility. They are mostly prepared by neutralizing the acid with strychnia, and evaporating:—

Strychniæ sulphas contains 7 Aq; it crystallizes in prisms and cubes, is efflorescent, and contains 75 per cent. strychnia. It is used, on account of its solubility, in preference to the alkaloid.

Strychniæ nitras crystallizes in needles of a pearly lustre, which are insoluble in alcohol.

Strychniæ murias is in silky needles, easily soluble in alcohol.

Strychniæ hydriodas is obtained by double decomposition as a white crystalline powder, little soluble in water, more in alcohol, and containing nearly 73 per cent. strychnia.

Strychniæ iodas is likewise obtained by double decomposition, and crystallizes in flat pearly needles, soluble in alcohol, but slightly in cold water.

Strychniæ acetas crystallizes with difficulty in white silky needles, very soluble in alcohol and water.

Strychniæ tannas is a white precipitate, scarcely soluble in water.

The medicinal uses of strychnia are those of a tonic, with a special action upon the nerves of motion. It is much employed in a variety of diseases, lately recommended in typhoid fever and spermatorrhœa. Dose, one-twelfth to one-sixth of a grain.

In doses exceeding two or three grains, strychnia is one of the most powerful and fatal of poisons. Immense quantities are sold for the purpose of killing animals, particularly dogs, on whom the most certain and rapidly fatal effect is produced by its use. In cases of poisoning by strychnia, the most prompt and vigorous efforts are necessary to arrest its effects. The jaws must be prevented from becoming permanently closed, as in tetanus. Emetics should be tried, but will seldom act. Tannic acid or other astringents administered immediately will precipitate alkaloid in an insoluble form. Chloroform has been found to arrest the effects of the poison. In one memorable case I saw the life of an individual saved by the application of the poles of a magnetic battery over the stomach, which aroused that organ, and, by excessive vomiting, produced complete expulsion of the poison and relaxation of the spasm.

Brucia. $C_{23}H_{26}N_2O_4$.

If strychnia is crystallized from a hot alcoholic solution, the mother-liquor contains nearly all the brucia; but it may be entirely freed from strychnia by nitric acid. From the neutral solution, the strychnia salt crystallizes first, leaving brucia in the mother-liquor; the acid solution, however, separates the brucia salt first in hard, four-sided prisms, while the strychnia salt crystallizes afterwards in fine needles.

It crystallizes in oblique four-sided prisms, dissolves in 850 parts cold, 500 parts boiling water, is easily soluble in alcohol, insoluble in ether; volatile oils dissolve a small quantity. Chloroform dissolves 56 per cent., and olive oil nearly 2 per cent. It contains 8 eq. of Aq.

The salts are bitter, crystallizable, precipitated by alkalies and alkaline earths, by morphia and strychnia; an excess of ammonia dissolves its precipitate; if acidulated with tartaric acid, no precipitate occurs on the addition of bicarbonate of sodium; concentrated nitric acid dissolves brucia and its salts to an intensely red fluid, which subsequently acquires a yellowish-red, and by heat a yellow tint; if now protochloride of tin or sulphuret of ammonium is added, an intense violet color is produced; concentrated sulphuric

acid colors it at first rose-red, afterwards yellowish-green; chlorine gas causes no precipitate.

The red color produced by nitric acid with brucia is so intense that Kersting has proposed a solution of the latter in 1000 water as a test for very minute quantities of the former; one 100,000th part HNO_3 with the brucia solution, over a layer of pure H_2SO_4, still produces at the margin of the two liquids a rose-red color, changing after a minute to yellow.

Of the salts used medicinally, the neutral sulphate crystallizes in needles with 4 Aq; the neutral nitrate is a gum-like mass, but the acid nitrate is crystallizable in four-sided prisms. Brucia is a less powerful therapeutic agent than strychnia, being safely employed in doses of from two to four grains.

Igasuria.

The mother-liquors of the former two, after their precipitation by lime, contain this alkaloid.

It crystallizes, is very bitter, dissolves in 200 parts boiling water, in weak alcohol, in acids, and alkalies. Sulphuric acid imparts a rose color, which turns yellowish or greenish.

The salts are soluble, crystallizable, and poisonous. They are precipitated in presence of tartaric acid by alkaline bicarbonates.

Schutzenberger has found that what has been called Igasuria is a mixture of various alkaloids, which he purified by fractional crystallization. They are all colorless, intensely bitter, poisonous like strychnia, soluble in boiling water and alcohol, slightly in ether; they crystallize in transparent needles or pearly scales, are colored red by nitric acid, lose their water of crystallization at 212°. Their salts are easily crystallizable. They are distinguished by affixing the letters of the alphabet:—

Igasuria,	*a*, $C_{22}H_{26}N_2O_4 3H_2O$.	Very slightly soluble.
"	*b*, $C_{18}H_{24}N_2O_4 3H_2O$.	Slightly soluble.
"	*c*, $C_{18}H_{24}N_2O_4 3H_2O$.	Moderately soluble.
"	*d*, $C_{17}H_{32}N_2O_8 3H_2O$.	" "
"	*e*, $C_{18}H_{26}N_2O_4 3H_2O$.	Soluble.
"	*f*, $C_{21}H_{30}N_2O_4 3H_2O$.	Moderately soluble.
"	*g*, $C_{21}H_{28}N_2O_6 3H_2O$.	Very slightly soluble.
"	*h*, $C_{21}H_{26}N_2O_6 2H_2O$.	Moderately soluble.
"	*i*, $C_{20}H_{26}N_2O_7 4H_2O$.	" "

Curaria.—The South American Arrow poison is supposed to be obtained from a plant of the family Apocynaceæ. Boussingault and Roulin discovered in it an uncrystallizable alkaloid, which was afterwards supposed by some chemists to be identical with strychnia, in consequence of the similarity of some of its reactions. This has recently been shown to be a mistake, however; in its physiological action it is quite the opposite of strychnia, and is regarded by some physicians as almost a perfect antidote to the poisonous effects of that alkaloid.

It is amorphous, yellowish, bitter, hygroscopic, soluble in water and alcohol, insoluble in ether and volatile oils. Its salts are uncrystallizable.

Pereirina is obtained from a Brazilian bark, known there by the names of pignaciba, pao pente, and pao pereira. It is prepared like the cinchona alkaloids, and lastly dissolved by ether. It is a yellowish-white amorphous, bitter mass, on melting blood-red, has an alkaline reaction, is little soluble in water, soluble in alcohol and ether. Concentrated sulphuric acid dissolves it with violet color, which afterwards turns brown, on diluting with water, olive-green and grass-green. Nitric acid dissolves it with a blood-red color, changing to grayish-brown. The salts are little known, they are precipitated by the oxalates, and are said to have febrifuge properties.

Castina is, according to Landerer, contained in the seeds of the "Chaste tree," is crystallizable, bitter, insoluble in water, soluble in alcohol, ether, and dilute acids, and precipitated from the latter solution by alkalies.

Convolvulina was obtained by Marquart from Scammony root; its sulphate crystallizes in radiating prisms.

Alkaloids of the Solanaceæ.

Solania.—The following comprises the older statements with regard to this principle:—

It is prepared from the potato germs by maceration with water acidulated with muriatic acid, mixing with hydrate of lime, and exhausting the precipitate with boiling alcohol; on cooling the greater part is separated. It crystallizes in colorless prisms, without odor; its taste is faintly bitter, nauseous, causes a persistent acrid feeling in the throat. It has an alkaline reaction, is slightly soluble in cold water, ether, alcohol, and fixed oils. It is a weak base, its salts are soluble, few crystallizable, and have a bitter taste, with lasting acrimony.

Solania, as obtained from the various species of Solanum, according to Moitessier, differs to a considerable extent in its physical properties. Various different alkaloids have probably been confounded under this name. Prepared from Solanum dulcamara, it has the composition $C_{43}H_{70}NO_{16}$, and all its salts are amorphous.

Zwenger announced a few years since that solania, a weak base, is split on boiling with dilute acids into glucose and a stronger base, which he called *solanidia*, $C_{50}H_{40}NO_2$, which is colored intensely red by sulphuric acid.

If solania is treated with cold concentrated mineral acids for several days, or if solanidia is boiled with diluted acids, the precipitate contains another alkaloid, *solanieda*, for which the formula $C_{0}H_{39}NO$ has been found. It is amorphous, yellowish, nearly tasteless, almost insoluble in alcohol, ether, and water. Its salts are deep yellow, amorphous, bitter, and astringent.

O. Gmelin, however, asserts that it contains no nitrogen, but that solanidia forms compounds with acids and with $PtCl_4$. Delffs regards solania as homologous with saponin, smilacin, and salicin.

Kromayer states that the solania which is prepared with mineral

acids invariably contains solanidia, the more if treated at an elevated temperature, and the latter can be dissolved by benzin. If potato germs are expressed, the liquid treated with excess of lime, the precipitate exhausted by boiling alcohol, and the gelatinous mass separating on cooling, repeatedly pressed, and redissolved, colorless acicular crystals are obtained, which are insoluble in ether. The expressed germs, treated in the cold with sulphuric acid and afterwards with lime, etc., yield amorphous solania, containing solanidia.

Dulcamarina, $C_{65}H_{50}NO_{27}$, (?) is said to exist in early spring in the stem of bittersweet besides solania. It is prepared by evaporating the infusion with marble dust, exhausting the extract with strong alcohol, evaporating, removing the lactate of calcium, adding ammonia, precipitating with tannin, and treating the precipitate with hydrated oxide of lead and alcohol.

Yellowish-white, amorphous, bitter, afterwards sweet, slightly soluble in water, ether, and acids, readily in alcohol.

Atropia. $C_{17}H_{23}NO_3$. (Equiv. 289.)

This alkaloid and its sulphate were made officinal in the *Pharmacopœia* of 1860; it is prepared by the following process:—

Powdered belladonna root is exhausted by alcohol; this is distilled off from the tincture, the residue acidulated with sulphuric acid, diluted with water, and filtered through paper; the filtrate is decomposed with potassa and repeatedly agitated with fresh portions of chloroform; the chloroformic solution is evaporated spontaneously.

Thus prepared it is in yellowish needles of a silky lustre, without odor, and of a bitter, acrid, almost metallic taste; it dilates the pupil more than any other alkaloid; to act on the pupil, atropia must have entered the circulation (Harley). It melts at 212°, is soluble in 200 parts of cold (300 parts at 60°, *U. S. P.*), 50 parts of boiling water, without crystallizing on cooling; by continued boiling it dissolves in 30 parts of water, from which the greater part crystallizes; it dissolves in 1½ parts cold alcohol; the solution in 6 parts of boiling ether gelatinizes on cooling into a transparent jelly. Chloroform dissolves 50, olive oil 2.3 per cent. atropia. The salts are crystallizable with difficulty without odor, and with the taste of atropia; they are mostly soluble in water, alcohol, and alcoholic ether, not in pure ether; all are very poisonous. Sulphuric acid dissolves the alkaloid without color, after some time the solution turns red and black. It is colored yellow by chlorine. Nitric acid dissolves it with a pale yellow color, afterwards orange, then colorless. The solution is then still precipitated by tannin, but does not contain any atropia, as the pupil is not dilated.

In contact with air it is easily converted into another alkaloid, which Berzelius has called *tropia*. It is very soluble in water, yellowish, not crystallizable, of a disagreeable odor, and strong alkaline reaction. According to Ludwig & Pfeiffer, atropia, by

being boiled with chromate of potassium and diluted sulphuric acid, gives off benzoic acid, and on the addition of potassa liberates propylamina. (See *Am. Journ. Pharm.*, 1862, p. 33.)

Atropiæ sulphas, U. S. P., is prepared by dissolving the alkaloid in strong ether and neutralizing with sulphuric acid diluted with a little alcohol; the sulphate is precipitated as a white crystalline powder.

It is very soluble in water and in alcohol, insoluble in ether, neutral to litmus, entirely dissipated by heat. Its uses are as a local anodyne in solution and ointment, 2 to 4 grains to the ounce, and for subcutaneous injection in neuralgia. For dilating the pupil 1 grain is dissolved in four fluidrachms of distilled water, and a drop or two applied to the inner surface of the lid. Dissolved in 100 parts of water one or two drops have been recommended as a local anæsthetic to facilitate the extraction of teeth. The dose internally is $\frac{1}{30}$th of a grain.

Atropiæ valerianas has recently been much recommended in chronic nervous complaints; it is prepared by dissolving atropia and valerianic acid separately in strong ether, cooling the solutions down to 32°, mixing and crystallizing at between 10° and 15° F. The crystals are soft at 68°, fuse at 90°, and turn yellow by light and air. Dose, the same as of sulphate.

Belladonnia is the yellow resin adhering to atropia and preventing it from crystallizing.

Crude atropia is dissolved in a weak acid, neutralized by carbonate of potassium to separate a body opalescing in blue, an alkali is added, taking care not to produce a pulverulent precipitate, as long as the precipitate appears oily and resin-like, this is collected on linen, dissolved in an acid, treated with animal charcoal, if necessary again fractionally precipitated, and dissolved in absolute ether.

A gum-like mass remains behind, of little bitterness, and a burning, sharp taste; it melts on heating and decomposes with the smell of hippuric acid; it is easily soluble in pure and officinal ether, in absolute and dilute alcohol, scarcely soluble in water; though strongly alkaline, it is less so than atropia; from the sulphate it is precipitated by ammonia as a white powder, which soon becomes resin-like. It was discovered by Hübschmann. It is most likely a product of decomposition from atropia.

Atrosia is the name given by Hübschmann to a black body, precipitated by ammonia from an aqueous solution of the alcoholic extract of the root; it is insoluble in alcohol, water, and ether, but dissolves in dilute acids with a red color. It is probably the cause of the red color of the juice of the fruit, and may be an alkaloid.

Daturia is obtained from stramonium seed by the above process for atropia; it has been proved to be chemically identical with atropia. Its pharmaco-dynamical properties have been studied by Professor Schroff, and carefully compared with those of atropia. His conclusions are, that their qualitative action is alike, but that

there exists a vast difference in their intensity, atropia being nearly twice as powerful as daturia.

Is there no doubt at all about their chemical identity?

Hyoscyamia is obtained from the seeds of hyoscyamus by the process for atropia.

It crystallizes in needles of silky lustre, when dry and pure without odor; the moist and impure has a disagreeable narcotic tobacco smell; its taste is acrid, tobacco-like. With a carefully regulated heat it may be distilled. It has a strong alkaline reaction, dissolves very readily in water, alcohol, and ether; and is easily decomposed when in solution. Nitric acid dissolves it without coloration; sulphuric acid colors it brown.

Of the salts, some few are crystallizable; they must be evaporated in vacuo to prevent them from becoming oxidized; they are soluble in water and alcohol, without smell, and have the taste of the base.

Capsicina is stated by Witting to be contained in the integuments of the seeds of red pepper; it is said to be a crystalline powder, insoluble in cold water and ether, slightly soluble in hot water and alcohol. Its sulphate, nitrate, and acetate are crystallizable, soluble in water, insoluble in alcohol, and precipitated by alkalies.

Buxina was prepared by Fauré from the leaves of boxwood, and described as a white powder, bitter, sternutatory, soluble in water, alcohol, and ether, and yielding with acids, salts, which crystallize with difficulty.

Prof. Walz has announced that this alkaloid is identical with bebeerina. (See below.)

Crotonina.—Brandes has separated from the seeds of Croton tiglium small crystals, fusible when heated, scarcely soluble in boiling water, soluble in boiling alcohol, with an alkaline reaction. Its phosphate and sulphate are crystallizable.

Euphorbina is a colorless, brittle mass, inodorous, bitter, and acrid, insoluble in water and ether, soluble in alcohol, decomposed by concentrated sulphuric and nitric acids; its salts are amorphous. It was obtained by Bushner and Herberger.

Bebeerina, $C_{19}H_{21}NO_3$, is the only alkaloid as yet discovered in the natural order of Lauraceæ. The suggestion of Walz that bebeeru bark might be derived from a Euphorbiaceous tree, is merely based on the asserted identity of this alkaloid with buxina, which fact has comparatively little weight since some other alkaloids have been proved to exist in several different families of plants.

It is best obtained, in a pure state, from the impure commercial sulphate by precipitating its solution with ammonia, redissolving the washed precipitate in acetic acid, adding an excess of acetate of lead, precipitating by potassa, and exhausting the precipitate by strong ether; the yellowish syrup left after the evaporation of the ether is dissolved in absolute alcohol, which solution, on being gradually poured into cold water, yields a flocculent precipitate, which is free from color after washing and drying.

It is amorphous, inodorous, bitter, of an alkaline reaction, fusible at 356°, scarcely soluble in water, readily soluble in ether and alcohol. The salts are bitter, amorphous, precipitated white by sulphocyanide and by iodide of potassium.

The commercial *Sulphate of bebeerina* is in dark-brown glittering scales, readily soluble in water by the aid of acids. It is esteemed as a tonic and antiperiodic, much prescribed in London in doses of three to ten grains, to the amount of a scruple or a drachm, between the paroxysms of intermittents.

Sepeerina (from the Dutch name sepeeri for bebeeru) remains behind after the exhaustion of bebeerina by ether.

Amorphous, reddish-brown, little soluble in water, soluble in alcohol. The salts are amorphous, of a brown color, and generally obtained in very shining laminæ, almost resembling crystalline scales.

Piperina, $C_{17}H_{19}NO_3$.—Powdered pepper is exhausted by alcohol; this is distilled off, the extract dried with lime in a water-bath, whereby the resin becomes insoluble while piperina is taken up by alcohol.

It crystallizes in four-sided prisms, colorless when pure, when chewed for some time developing a hot peppery taste, scarcely soluble in water, easily in alcohol, less in ether, the solution is neutral to litmus, and has a burning pepper taste. It melts at 212°, losing 2 equivalents of water. It dissolves in cold sulphuric acid with a deep red color; concentrated nitric acid decomposes it, the brown mass dissolves in potassa with a red color, and yields on boiling *piperidina*. By continued boiling with an alcoholic solution of potassa, it splits into piperic acid and piperidina, $C_{17}H_{19}NO_3H_2O = C_5H_{11}N + C_{12}H_{10}O_4$ ($\overline{Pip}$).

It has been recommended as an energetic and rapid febrifuge, though chiefly used in combination with quinia. It is given in doses of 2 to 4 grains, but may be increased to 60 grains in 24 hours without injurious effects. Landerer believes that the same alkaloid is also contained in the berries of Schinus mollis, Terebinthaceæ. (See *Amer. Journ. Pharm.*, 1863, 157.)

Piperidina, $C_5H_{11}N$, is probably ethyl-allyl-amina, $N(C_2H_5 + C_3H_5 + H)$.

It is a colorless liquid, strongly alkaline, of an ammoniacal and peppery odor and taste, lighter than water, in which it dissolves in all proportions; boiling point 223° F.; it precipitates the salts of the metallic oxides. Its salts are crystallizable.

Piperic acid, $\overline{Pip} = C_{12}H_{10}O_4$, is nearly insoluble in water, slightly soluble in ether, readily in boiling alcohol; fusible at 300°, partly sublimable at 390° with the odor of coumarin; sulphuric acid colors it blood-red, and it yields with PCl_5 vermilion-red crystals. Piperate of Piperidina crystallizes in colorless silky scales, turning yellow in the air, fusible at 248°; piperina cannot be obtained from them.

Veratria, U. S. P.

Veratria is procured from cevadilla seeds by treating them with alcohol, evaporating the tincture to an extract, and treating this with water acidulated with sulphuric acid; this solution, containing sulphate of veratria, is next evaporated to a syrupy consistence, decomposed by magnesia, which is added in slight excess; the precipitated veratria thrown down is now washed and separated from the excess of magnesia by alcohol, from which it is obtained by evaporation, but requires still further purifying with animal charcoal, etc. A pound of the seeds yields about a drachm of veratria.

This product is a white, uncrystallizable powder, extremely acrid when diffused in the air, producing excessive irritation of the nostrils. It is freely soluble in alcohol, less so in ether, and almost insoluble in water, but soluble in diluted acids, from which ammonia and solution of tannin throw down white precipitates. Among its most striking peculiarities are the intense red color it assumes on the addition of sulphuric acid, and the yellow solution it forms with nitric. Veratria, as procured by the officinal process, is a complex body, and contains two alkaloids, *sabadillia* and *jervia*, with some resinous matter.

The medical uses of veratria are confined chiefly to gouty and neuralgic affections, in the treatment of which it is used internally in doses of one-twelfth to one-sixth grain, repeated, or externally, in ointment, of about ℈j to the ounce; it has lately also been recommended in typhoid fever.

The following is the process for obtaining the alkaloids pure:—

Veratria, $C_{32}H_{52}N_2O_8$.—Commercial veratria is dissolved in much alcohol, and mixed with water until a precipitate just commences to appear; on spontaneous evaporation, a white, crystalline powder is obtained, mixed with a brown, resinous mass, which can be removed by washing with cold alcohol. The powder, if dissolved in strong alcohol, and evaporated spontaneously, leaves large, rhombic, colorless prisms, which effloresce in the air, become porcellaneous and pulverulent, are insoluble, but rendered opaque in boiling water, readily soluble in alcohol and ether. Sulphuric acid colors it yellow, then carmine red; muriatic acid produces a deep violet solution with oily drops on the surface. The acids are completely neutralized, but the solutions do not crystallize on evaporation.

Sabadillia, $C_{20}H_{25}N_2O_5$, crystallizes in colorless prisms, which are soluble in boiling water, melt at 390° F., and have a very acrid taste. It is easily soluble in alcohol, but does not crystallize from this solution; it is insoluble in ether, and, from its solution in dilute sulphuric acid, is not precipitated by ammonia. It is not sternutatory. (Hübschmann.)

Jervia, $C_{30}H_{46}N_2O_3$.—The precipitate by soda, containing the alkaloids, is boiled with diluted sulphuric acid; on cooling, the sulphate of jervia is precipitated. The precipitate may be decomposed by carbonate of sodium, and recrystallized from alcohol.

It is nearly insoluble in water, soluble in alcohol, crystallizes in

colorless prisms with 4 Aq, loses its water of crystallization on heating, melts at 375°, and is decomposed at a higher heat.

Jervia and its soluble salts are precipitated from their solutions by muriatic, sulphuric, and nitric acids, forming therewith nearly insoluble salts; they, however, dissolve in alcohol.

Colchicia.—According to Aschoff, the root is to be exhausted by cold water, precipitated by basic acetate of lead, the filtrate neutralized by carbonate of sodium, the filtrate precipitated by tannin, this precipitate washed, expressed, dissolved in eight parts alcohol, and digested with freshly precipitated oxide of iron; the filtrate is evaporated, the residue dissolved in a mixture of equal parts of alcohol and ether, evaporated, and again dissolved in water.

The corms gathered in spring yielded but .75 grains, in the fall as high as 6.5 grains from the pound; the seed 16 grains to the pound.

It is a white amorphous mass, of a bitter, not acrid taste, without odor, when moist of a feeble narcotic odor. It is easily decomposed in aqueous solution, is not sternutatory or hygroscopic, is fusible and inflammable, easily soluble in water and alcohol, less in absolute ether. It has no reaction on vegetable colors. The following is its behavior to reagents:—

It is soluble in H_2SO_4, with a clear yellow color; in HNO_3, yellow; the undissolved colchicia is brownish-red, then violet, brownish-green, brown-red; fuming HNO_3 (containing nitrous acid) imparts to it a violet or indigo-blue, afterwards yellow, color. The solution of $\frac{1}{100}$ colchicia is colored lemon yellow by muriatic acid. Bichromate of potassium and sulphuric acid impart a green color. Iodine causes a kermes-colored, gelatinous precipitate, soluble in alcohol and water. Chlorine water a yellow precipitate, soluble with orange color in ammonia. No crystallizable compounds have been obtained with acids, except that J. E. Carter thinks he obtained a crystalline sulphate.

Hübschmann was unable to saturate two drops of dilute sulphuric acid with colchicia, though he and Carter both found it to act slowly on reddened litmus paper, and on paper colored with rhubarb.

Oberlin disputes the existence of a base colchicia, so does Walz, who renders it probable that it is a glucoside. An alkaloid does, however, appear to exist in colchicum, since the infusion yields precipitates, both with Sonnenschein's and Mayer's tests.

By external application, several painful cases of rheumatism have been relieved by it. If given internally, one-sixtieth ($\frac{1}{60}$) grain three times daily, continued, if necessary, for several weeks, has a most salutary effect in rheumatic complaints. It opens the bowels even of those who have been suffering from constipation. (See Thesis of J. E. Carter, of Philadelphia, *Am. Journ. Pharm.*, vol. xxx. p. 205.)

Colchiceine, $C_{35}H_{44}N_2O_4$.—Oberlin obtained no colchicia by Geiger and Hesse's process, but, on dissolving the product in water, acidulating with muriatic acid, evaporating until of an intense yellow

color, a white precipitate was thrown down by water, crystallizing from alcohol and ether in pearly lamellæ, of an intensely bitter taste, neutral to test paper, nearly insoluble in water, soluble in alcohol, ether, wood-spirit, chloroform, ammonia, and potassa; in ferric chloride with green, in sulphuric acid with yellow, in muriatic acid with pale yellow, in nitric acid with intense yellow color, changing to violet, deep red, light red, and yellow. It is very poisonous.

It remains to be investigated whether or not it is a product of decomposition of colchicia by the influence of muriatic acid.

Apirina was obtained by Bizio from the seeds of Cocos lapidea. It is white, inodorous, of a sharp taste, fusible, soluble in 600 p. water, without alkaline reaction; forms with acids crystalline salts, which are less soluble in hot than in cold water.

Tests for Distinguishing the Alkaloids.

The following, taken from Dr. A. T. Thompson, conveys in a compact form the leading facts applicable to distinguishing the alkaloids. Some *general* characteristics are noticed at the beginning of this chapter, and the *particular* ones under the several heads.

Method of Distinguishing the following Vegetable Alkaloids—Atropia Brucia, Delphia, Emetia, Morphia, Solania, Strychnia, Veratria—when they are in powder.

Treat the powder first with nitric acid, which is colored red by *brucia*, *delphia*, *morphia*, and the *strychnia* of commerce, but not by pure strychnia. If the reddened acid become of a violet hue on the addition of protochloride of tin, after the nitric solution has cooled, the alkaline powder is *brucia;* if the reddened acid gradually become black and carbonaceous, it is *delphia.* If the powder be fusible without decomposition, and decomposes iodic acid, evolving free iodine, it is *morphia;* if it is not fusible, and does not decompose iodic acid, it is *strychnia.* If the powder greens, instead of reddens nitric acid, it is *solania;* if it is insoluble in ether, and does not redden nitric acid, it is *emetia;* if it be soluble in ether and does not redden nitric acid, but melts when heated, and volatilizes, it is *atropia;* if it is thus affected by ether and nitric acid, but is not volatilized, it is *veratria.*

The Ternary Alkaloids.

Sparteina, $C_{10}H_{26}N_2$.—A concentrated decoction of broom is distilled with soda, and several times rectified.

It is a colorless oil, which, in contact with water, soon becomes opalescent, and is colored brown by the air; it is heavier than water, smells faintly like anilina, has a very bitter taste, and is narcotic; its boiling point is 550° F. Acids are perfectly neutralized; the salts are soluble, the muriate and nitrate not crystallizable.

Conia, $C_8H_{15}N$, is most abundant in the fresh plants gathered before flowering, and in the seed of the second year's growth, from

which it is obtained by distillation with caustic potassa, purifying the sulphate by dissolving it in alcoholic ether, and again distilling with potassa. Thus obtained it frequently contains methyl and ethyl-conia. The seeds are richest in the alkaloid just before ripening.

Conia is a volatile colorless or yellowish oily fluid (specific gravity .87), with a very characteristic odor resembling that of the urine of the mouse. It boils at 338°, is neutral to test paper when anhydrous, but decidedly alkaline when containing some water. It is soluble in 100 parts of water, floating on its surface when distilled with it. Alcohol dissolves it readily, as also ether, the fixed and volatile oils. It does not dilate the pupil, but is extremely poisonous.

Like other volatile alkaloids of the composition of substituted ammonia, it occasions white clouds when approached with a rod moistened with muriatic acid. This test, when applied to the extract of conium, after adding to it on a tile a few drops of solution of potassa, is resorted to, in connection with the odor, in judging of the quality of that extract.

When exposed to the air, conia undergoes oxidation, being converted into a brown resinous matter, ammonia, and butyric acid; butyric acid is also formed by the reaction with nitric and chromic acids. By muriatic acid gas it is colored purple, changing to blue; chlorine produces thick white vapors of a lemon odor.

It neutralizes the acids, forming soluble salts, some of which are crystallizable, while those with oxygenated acids are most decomposed on evaporation and leave a gummy residue.

Methylconia, $C_9H_{17}N$, resembles conia in physical and chemical properties, and can be distinguished from it only by elementary analysis.

Ethylconia, $C_{10}H_{19}N$, is very similar, but less soluble in water.

In this connection it is proper to mention the quaternary alkaloid, discovered by Wertheim, accompanying conia.

Conhydrina, $C_8H_{17}NO$, occurs chiefly in the flowers and seed of conium; to prepare it, the crude conia is neutralized with sulphuric acid, the salt extracted with alcohol to separate ammonia, evaporated, treated with concentrated caustic potassa, then with ether; this is distilled off, and by very slow fractional distillation in an oil-bath, the conia is separated; between 300° and 400° crystals of conhydrina are sublimed.

It is in colorless, pearly crystalline lamellæ, sublimes slowly below 212°, insoluble in water, alcohol, and ether; by distillation with anhydrous phosphoric acid, conia is obtained, H_2O being abstracted: $NC_8H_{17}O - H_2O = NC_8H_{15}$.

Its action on animals is similar to conia, but much weaker. The salts have not been studied.

Cicutina.—The root of cicuta virosa yields, according to Polex, by exhausting with a diluted acid and distillation with an alkali, this alkaloid, which has a very agreeable odor.

Chærophyllina.—Its sulphate was obtained by Polstorf by distil-

ling the fruit of Chærophyllum bulbosum with potassa, and neutralizing the distillate by sulphuric acid; iridescent laminæ.

Aribina, $C_{23}H_{20}N$, was obtained by Rieth from the Brazilian tree Arariba rubra, and is remarkable for being the first natural vegetable alkali of ternary composition which is solid at ordinary temperature.

Hygrina is a volatile base obtained by Lossen from coca leaves; its odor recalls that of propylamina; it is not poisonous. It is probably a product of decomposition.

Lobelina was discovered by the late Prof. S. Calhoun, of Philadelphia, in 1834, and first isolated in a state of purity by Professor Procter, in 1842. It is most conveniently obtained by extracting the seed with alcohol acidulated with acetic acid, evaporating, and treating with magnesia, and then with ether, from which it may be obtained by spontaneous evaporation.

It is a liquid lighter than water, and when dropped into that fluid rises to its surface and spreads out like a drop of oil, then gradually dissolves without agitation, forming a transparent solution. It is very soluble in alcohol and ether, the latter readily removing it from an aqueous solution; it also dissolves in fixed and volatile oils. It forms crystallizable salts, with numerous acids.

It is not obtained on an economical scale for use in medicine. Lobelina, as it exists in the plant combined with lobelic acid, is decomposable by a moderate heat, as also by the action of strong acids.

Nicotia, or *Nicotina*, $C_{10}H_{14}N_2$, is prepared in the following manner: The acid infusion of tobacco is evaporated to about one-half, and distilled with caustic potassa; or tobacco is distilled with milk of lime; the distillate is neutralized by oxalic acid, crystallized, the crystals washed with ether, decomposed by potassa, and the alkaloid dissolved by ether. By rectification in a current of hydrogen, it may be obtained colorless.

It is a colorless, oily liquid, of strong tobacco odor, a burning sharp taste, heavier than water, specific gravity 1.048. It is inflammable, has an alkaline reaction, is soluble in water, and water is soluble in it to some extent; miscible with alcohol, ether, and olive oil, scarcely soluble in oil of turpentine. It becomes yellow by keeping, absorbing oxygen from the air, which gradually turns it thick and brown. It boils at 482° F., but volatilizes at a much lower temperature. The vapor which rises is so powerful in its smell and irritating properties that one drop of it diffused in a room renders the atmosphere insupportable. The volatility of this principle insures its diffusion, along with empyreumatic products, in tobacco smoke, so that it is inhaled to a certain extent by smokers; tobacco smoke may be freed from it by passing it over cotton saturated with tannin. It exists in the different commercial varieties of tobacco in about the following proportions; Havana, 2 per cent., Maryland, 2.3, Virginia, 6.87, Kentucky, 6.09.

Orfila has lately investigated the properties of nicotia, and ascertained with precision its chemical habitudes. These are detailed in a paper copied in the *Am. Journ. of Pharm.*, vol. xxiv. p. 142, from

the *London Pharm. Journ.* *See also* a paper by Professor Procter in *Proc. of Am. Pharm. Asso.*, 1858, p. 295.

Its salts have a burning taste of tobacco, are very soluble in water, deliquescent, and difficult to crystallize.

Mercurialina.—By distillation with lime from the herb and seeds of Mercurialis annua, an oily alkaloid is obtained, which resembles in odor both nicotia and conia; it is readily oxidized, and thickens in contact with the air. The salts are mostly soluble in water and alcohol.

Secalina, C_3H_9N, or *Propylamina*, has the atomic composition of C_3H_7,H_2N, methylæthylamina $CH_3C_2H_5HN$, and trimethylamina $(CH_3)_3N$, and is identical with one of them, probably the former, as it may be obtained from propylic narcotina by distillation with potassa. Besides the plants mentioned in the syllabus, it has been obtained from the ergot of maize, from herring-pickle, crabs, the spirits in which anatomical preparations have been kept, and the urine of man. When artificially prepared, it is best known in medicine as *Propylamina*, though chemists generally regard it as trimethylamina.

Propylamina is most economically prepared from herring-pickle by distillation with caustic potassa, neutralizing the distillate with muriatic acid, purifying the salt by dissolving it in strong alcohol or alcoholic ether, and again distilling with potassa.

It is a colorless liquid of a strong odor of herrings, and a sweetish astringent taste; it is soluble in water, has an alkaline reaction, produces white vapors with muriatic acid. It is combustible, and mixed with an equal bulk of water it can still be ignited. Its salts are mostly soluble in water and alcohol, and crystallizable.

According to Dr. Awenarius, of St. Petersburg, it appears to be a true specific for rheumatic affections, the acute as well as the chronic. He administered it in mixture, containing 24 drops of propylamina to 6 ounces of mint-water sweetened with 2 drachms of sugar, and gave it in doses of a tablespoonful every two hours. Whether it is capable of promoting uterine contraction has not been ascertained.

Murias Propylaminæ is the form most used in practice in the United States; it is prepared by crystallizing the product as at first obtained by passing the volatile alkaloid into diluted muriatic acid, as above; to free it from muriate of ammonium it may be recrystallized from its solution in strong alcohol. It is usually called chloride of propylamin, destitute of the unpleasant odor of the alkaloid itself, and has been found a useful remedy in rheumatism, in doses of from 3 to 5 grains. (*See* Propylamin Cordial.)

See papers on this subject by Professor Procter in *Proceedings of the American Pharmaceutical Association*, 1857, and *American Journal of Pharmacy*, xxxi. 125 and 222.

Anilina, $C_6H_5H_2N$, also known by the names of phenylamina, phenamide, kyanole, crystalline, and benzidam; it is the only artificial alkaloid which has been used in medicine. It is best prepared, on a small scale, by the process of Béchamp, from 10 p.

nitrobenzole, 12 p. iron filings, and 10 p. strong acetic acid. The reaction takes place without the application of heat, but to insure complete reduction, the spontaneous distillate is returned to the retort and again distilled, when it may be at once combined with sulphuric acid to form the medicinal sulphate.

The alkaloid is a colorless oil, of vinous odor and aromatic taste; spec. grav. 1.2; boiling point 360°; coagulates albumen; in contact with air turns yellow and resinifies; separates many metallic oxides from their salts; colors pine wood yellow; by hypochlorites blue; by HNO_3 blue, and on heating oxidized to picric acid; by H_2SO_4 and K_2CrO_4 blue, but of a different shade, as that produced under the same circumstances with strychnia.

Within a few years past it has become of great technical importance, since its products of oxidation by various agents have been made use of to dye animal fabrics, like silk and wool.

Anilinæ sulphas is prepared by direct combination; it dissolves in about 16 parts of water at 60°, slightly in cold alcohol, insoluble in ether; it is colorless and crystalline, but acquires a reddish color, when exposed to the air in a moist state.

This salt has gained some reputation since Dr. Turnbull, of Liverpool, announced his success in treating with it a number of cases of chorea; the remedy produces a transient alteration in the color of the skin and lips, which disappears, however, as soon as it is laid aside. (See *Am. Journ. Pharm.*, 1862, 295.)

Alkaloids of Animal Origin.

Some animal tissues and liquids contain alkaline substances or are decomposed into such by the influence of various chemical agents. These animal alkaloids, however, are as yet of little importance in a medicinal point of view; and it remains here merely to draw attention to a few of them which are either contained in culinary and dietetic articles, or are of importance from their presence in various secretions.

Creatine, $C_4H_9N_3O_2H_2O$.—Though creatine is a neutral substance, it may be well to refer to it in this place. It is prepared by expresing fresh meat, macerating it several times with water, and subjecting it each time to strong pressure. From the mixed liquids, albumen and fibrin are removed by coagulating with heat, and solution of baryta is added as long as a precipitate occurs; the filtrate is evaporated at a moderate heat to a syrupy liquid, and set aside to crystallize.

The flesh of chickens and game is easy to clarify; the former contains the largest, fishes the least quantity of creatine. It is in colorless pearly crystals without taste or action on litmus; it is soluble in 75 parts of cold water, and in 100 parts of absolute alcohol. By boiling with baryta it is decomposed into sarkosina and urea; by evaporating with strong acids, it loses H_2O and is converted into creatinina.

Syllabus of Animal Alkaloids and the Products of their Decomposition.

Cratinina or Creatinina, $C_4H_9N_3O_2H_2O$. In the urine of calves, in flesh, and from creatine by acids; colorless crystals; soluble in 11 water, 100 alcohol, and much ether; expels NH_3 from its salts.

Sarkosina, $C_3H_7NO_2$. From creatine by boiling with BaO; rhombic prisms or scales, easily soluble in water, slightly in alcohol; insoluble in ether; fusible at 212°.

Glycina, $C_2H_5NO_2$, *Glycocol* or *amido-acetic acid.* In the bile; by treating glue or similar substances with boiling alkalies or acids; sweet rhombic crystals, easily soluble in water and dilute alcohol, slight acid reaction; combines with acids and with bases.

Leucina, $C_6H_{13}NO_2$, or *amido-capronic acid.* In various organs of all animals except the very lowest, by putrefaction of casein, from glue like glycina. Shining scales, easily soluble in water, alkalies, and muriatic acid, slightly in alcohol; insoluble in ether and chloroform; sublimable; fused with KO yields valerianic acid.

Tyrosina, $C_9H_{11}NO_3$. In the liver, pancreas, and other parts of man and many animals; in American extract of rhatany (Wittstein), by acids or alkalies upon casein, glue, albumen, etc. Silky needles, soluble in acids and alkalies, slightly in water; insoluble in alcohol and ether; combined with H_2SO_4 it colors Fe_2Cl_3 violet.

Guanina, $C_5H_5N_5O$. In the excrements of spiders and in small quantity in guano; white powder, insoluble in water, alcohol, and ether, somewhat soluble in lime and baryta water; its salts crystallizable; precipitated by acetic and formic acids.

Taurina, $C_2H_7NSO_3$. In the lungs and kidneys of the ox and in bile after decomposition by acids or by fermentation; six-sided prisms, easily soluble in water, slightly in alcohol; taste cooling; not destroyed by H_2SO_4 or HNO_3.

Urea, CH_4N_2O. In the blood, urine, and eye of the mammalia, particularly the carnivorous; in many organs of some lower animals.

Urea has been proposed as a remedial agent; its mode of preparation is as follows:—

Urine is evaporated to a syrupy consistence, mixed with an equal volume of nitric acid, and set aside for twenty-four hours in a cool place; the crystals are redissolved in boiling nitric acid to destroy coloring matter, if necessary digested with animal charcoal, and subsequently decomposed by carbonate of barium. After evaporation, the mass is exhausted by alcohol.

For its artificial preparation Liebig gives the following directions: A mixture of four parts finely powdered anhydrous ferrocyanide of potassium, one and a half parts carbonate of potassium, and two parts black oxide of manganesium is heated to redness, and constantly stirred until it has ignited; it is extracted with cold water, the solution mixed with a solution of three parts sulphate of ammonium, evaporated, the sulphate of potassium removed as much as possible, and the residue exhausted with boiling ordinary alcohol.

Urea crystallizes in long, colorless prisms, of a cooling taste similar to saltpetre, easily soluble in water and alcohol, insoluble in ether, containing no water of crystallization, and fusing at 248° F.; combines with acids and bases.

It has been recommended as a good and reliable diuretic, in doses of from five to ten grains, several times a day, in diabetes, albuminuria, and dropsy.

Ureæ nitras is precipitated from a concentrated solution of urea by strong nitric acid in anhydrous white shining scales, soluble in

eight parts of water, slightly in nitric acid and alcohol. Its action is said to be similar to urea, and it has been recommended as a solvent for vesical calculi composed of ammonio-phosphate of magnesium. It contains 52.63 per cent. urea.

CHAPTER IX.

ON NEUTRAL ORGANIC PRINCIPLES, MOSTLY PECULIAR TO A LIMITED NUMBER OF PLANTS, AND POSSESSED OF MEDICINAL PROPERTIES.

Formerly, the virtues of most medical plants were attributed to *extractive* matter, though this, as obtained from various sources and by different analytical processes, was known to vary somewhat in its properties.

By the improved means of proximate analysis many of these plants have been found to possess certain well-defined principles, sometimes crystalline and sometimes amorphous, to which appropriate names have been given. If *alkaline*, these names should terminate in *ia;* if *neutral* or *subacid*, in *in* or *ine*. This arrangement, which would conduce to accuracy if invariably observed, is, however, not adhered to universally, and in Europe is repudiated by some high authorities.

The neutral principles are in some instances active, and in others appear to possess little power of affecting the system. Some of them contain nitrogen, while most others consist of merely carbon, hydrogen, and oxygen. These principles occasionally unite with acids, forming crystalline compounds, which are, however, acid in their properties; others, combining with alkalies and forming crystallizable salts, have been considered among the acids. Many of them belong to the so-called copulated compounds, and decompose under the influence of emulsin, albumen, pectase, or when heated with diluted mineral acids or alkalies, into glucose or some similar sugar and another compound. They are generally precipitated by tannic acid, and many of them by subacetate of lead. The modes of obtaining these principles are various, and sometimes difficult to follow, though the solubilities and chemical peculiarities of each, when ascertained, indicate approximately its mode of extraction.

In a work of the design and scope of the present, it will suffice to display the more striking peculiarities of these principles, none of which are officinal, in a syllabus, and to give the processes of extraction and the leading chemical and medicinal characteristics, only in a few cases including the more important and familiar.

There are here, as in the case of the alkaloids, no known chemical relations upon which we would be justified in founding a scientific classification of these principles, and here, as in treating of the other proximate principles of plants, we will find the botanical

arrangement of the plants themselves to afford the best grouping. The natural families of plants, though arranged upon a purely botanical basis, are found to exhibit remarkable chemical and physiological relations among the products of their individual members; this agreement, as yet but imperfectly recognized owing to our limited knowledge of the actual composition of organic proximate principles, is probably one of the great universal harmonies of nature, which, in the progress of science, will be more fully developed and made known.

Syllabus of Plants and their Neutral Characteristic Principles. (Generally Crystalline.)

1. *Ternary Compounds.*

Ranunculaceæ.	
Cimicifuga racemosa.	Crystals insoluble in water, benzine, turpentine, bisulphide of carbon; soluble in alcohol, diluted alcohol, and chloroform; sparingly soluble in ether; easily fused.
Pulsatilla pratensis. (Anemone pratensis.)	*Anemonin*, associated with anemonic acid; rhombic crystals, nearly insoluble in ether; product of the decomposition of the acrid oil of Ranunculus scleratus. Poisonous.
Magnoliaceæ.	
Liriodendron tulipifera. Magnolia glauca, etc.	*Liriodendrin*, white scales, or needles; little soluble in cold water; soluble in alcohol and ether; bitter, pungent; partly sublimable.
Magnolia Tripetala.	*Magnolia*, a crystalline (resinoid) principle, nearly insoluble in cold water, very soluble in chloroform, ether, bisulphide of carbon, and alcohol; soluble in hot glycerine; fusible at 180° F.
Menispermaceæ.	
Cocculus palmatus. Calumba, *U. S.* (The root.)	*Columbin*, $C_{21}H_{22}O_7$, colorless, rhombic prisms, fusible; very bitter; soluble in 30 parts alcohol, in ether, volatile oils, acetic acid, and in alkalies; reprecipitated by acids, not precipitated by tannin. Associated with *berberina.*
Papaveraceæ.	
Papaver somniferum. Opium, *U. S.*	*Meconin*, $C_{10}H_{10}O_4$, white acicular crystals, soluble in 265 parts cold, 18 boiling water, ether, alcohol, and volatile oils; acrid.
Caryophylleæ.	
Saponaria officinalis. Gypsophylla struthium. Agrostemma githago.	*Saponin*,* $C_{12}H_{20}O_7$, *Struthiin*, *Githagin*, identical; white powder; soluble in hot water and diluted alcohol, insoluble in ether; taste sweetish, afterwards acrid and bitter; frothing in solution; sternutatory; splits with H_2SO_4 into sugar and *sapogenin*, $C_{14}H_{22}O_4$ (Bolley), or *kinovin* (Rochleder).
Linaceæ.	
Linum catharticum. Purging flax.	*Linin*, white powder or silky needles; sparingly soluble in water, more in acetic acid and chloroform; freely in alcohol and ether; the alcoholic solution intensely bitter and acrid; by H_2SO_4 violet.
Aurantiaceæ.	
Citrus vulgaris. Aurantii amari cortex, *U. S.* Citrus aurantium. Aurantii dulcis cortex, *U. S.* Citrus limonis. Limonis cortex, *U. S*	*Hesperidin*, in the spongy portion of lemon peel, bitter; crystalline; soluble in alkalies and hot alcohol, little in water; insoluble in ether and volatile oils; by Fe_2C_3 red-brown.

* Similar, if not identical, principles occur in numerous plants, the decoctions and tinctures of which have the property of frothing like soap-water. (*See* Polygalic Acid, Cyclamin, Convallarin, Smilacin, Aphrodæsin.)

Citrus limonum and citrus aurantium. The seed.	*Limonin*, $C_{42}H_{50}O_{13}$. From the seed by alcohol, crystalline, bitter, soluble in KO; red color with H_2SO_4; scarcely soluble in ether.
Guttiferæ.	
Garcinia mangostana.* Bark of the fruit.	*Mangostin*, $C_{20}H_{22}O_5$, golden-yellow scales, without smell or taste; insoluble in water; soluble in alcohol and ether, diluted acids and alkalies.
Zygophylleæ.	
Guaiacum officinale. The wood and bark.	*Guaiacin*, uncrystallizable, bitter, and acrid; light yellow powder; easily soluble in hot water and alcohol; insoluble in ether; precipitated by acids.
Erythroxyleæ.	
Erythroxylon cocoa. Leaves.	*Erythroxylin*, volatile, needle-shaped crystals, very bitter, probably identical with *caffein*. (*See* Cocaina.)
Hippocastaneæ.	
Æsculus hippocastanum. (Horse chestnut.) The bark.	*Æsculin*, $C_{21}H_{24}O_{13}$, *polychrom*, white crystalline powder, without smell, bitter; little soluble in cold water and alcohol; soluble in alkalies; insoluble in ether and volatile oils. (See page 528.)
The Cotyledons.	*Argyræscin*, $C_{54}H_{86}O_{24}$, crystallizes from diluted alcohol; silvery in appearance; insoluble in ether; gelatinizes with warm alkalies, and forms *æscinic* and *propionic acids;* by H_2SO_4, yellow solution, blood-red on addition of Aq; by dilute acids splits into sugar and *argyræscetin* $= C_{42}H_{62}O_{12}$.
	Aphrodæsin, $C_{104}H_{85}O_{47}$, amorphous, colorless, sternutatory; resembles saponin in many respects; splits by alkalies into *butyric* and *æscinic acid*, $C_{43}H_{80}O_{46}$.
Various species of Æsculus and barks of the genus *Pavia.*	*Paviin*, similar to æsculin, identical with fraxin. (*See* Oleaceæ.)
Rutaceæ.	
Gallipea officinalis. The bark. Angustura, *U. S.*	*Cusparin*, tetrahedral crystals, soluble in alcohol, acids, and alkalies, and in 200 parts water; precipitated by tannic acid.
Xanthoxylum piperitum. The fruit.	*Xanthoxylin*, volatile, insoluble in water; soluble in alcohol, ether; aromatic resinous taste; stearoptene from the oil.
Xanthoxylum fraxineum. Xanthoxylum, *U. S.* (The bark.)	*Xanthoxylin* of Dr. Staples, not investigated, probably identical with xanthopicrin (Dr. Wood). (*See* Berberina.)
Terebinthaceæ.	
Anacardium occidentale, cashew nut.	*Cardol*, $C_{21}H_{31}O_2$, light-reddish oil, very readily oxidizing; insoluble in water; easily soluble in alcohol and ether; very acrid and blistering.
Simarubaceæ.	
Simaruba excelsa; Quassia, *U. S.*, and Simaruba officinalis, Simaruba, *U. S.*	*Quassin*, $C_{10}H_{12}O_3$, white opaque granules, or prisms; inodorous, intensely bitter; very soluble in alcohol, less in ether, slightly in water, not precipitated by tannin. (See page 529.)
Sapotaceæ.	
Chrysophyllum glycophlæum, Monesia bark.	*Monesin*, gummy, or white powder; inodorous, bitter, and acrid; readily soluble in water and alcohol, the solutions frothing; slightly soluble in absolute alcohol and ether; identical with saponin. ?
Aquifoliaceæ.	
Ilex aquifolium. European holly. The leaves.	*Ilicin*, brown-yellow transparent crystals; bitter; readily soluble in alcohol and water; insoluble in ether; not precipitated by metallic salts.
Ilex opaca. American holly. The fruit.	*Ilipicrin*,† acicular crystals, intensely bitter, slightly acrid, soluble in water and alcohol, freely in ether; precipitated by tannin.

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* Used in the East India Islands as a remedy for intermittents.

† We propose to retain the name of *ilicin* for Delschamp's still impure principle as obtained from the leaves of European holly, and suggest the name *ilipicrin* for the crystalline bitter principle obtained from the fruit of American holly, as obtained by Dillwyn P. Pancoast, a graduate of the Phila. College Pharm. (See *Amer. Journ. Ph.*, 1856, p. 314.)

Rhamneæ.	
Rhamnus frangula and cathartica.	*Rhamnin*, volatile, tasteless, yellowish crystals; soluble in alkalies with yellow color (Fleury).
The unripe berries (buckthorn).	*Cathartin* of Winkler, from the ripe fruit. Cathartic dose 1 to 3 grs. (*See* Crysophanic Acid.)
Rhamnus infectoria, French berries.	*Rhamnin*, a coloring principle soluble in water, *Rhamnetin*, coloring principle insoluble in water, Rhamnotannic acid.
Leguminosæ.	
Cassia fistula. The root.	*Cassiin*, uncrystallizable, bitter; soluble in water and alcohol; precipitated by mineral acids.
Cassia acutifolia, C. obovata, C. elongata, Senna, *U. S.*	*Cathartin* of Lassaigne and Fenuelle. (*See* Chrysophanic Acid.)
Lupinus albus. White lupine. The seed.	*Lupinine*, greenish, amorphous, hygroscopic, bitter; insoluble in absolute alcohol and ether.
Glycyrrhiza glabra. Liquorice.	*Glycyrrhizin* is a glucoside, splitting into glycyretine and sugar (Gorup Besanez).
Dipterix odorata, fruit. (Tonka beans.)	*Coumarin*, $C_9H_6O_2$.* Colorless, quadrangular prisms; odor and taste aromatic; destroyed by H_2SO_4; by HNO_3 converted into nitro-coumarin and picric acid; by boiling with alkalies, coumaric acid $C_9H_8O_3$. 1 lb. Tonka beans yield 108 grs.
Melilotus officinalis. Flowers.	
Cytisus scoparius. Scoparius, *U. S.* (Broom).	*Scoparin*, $C_{21}H_{22}O_{10}$, soluble in alkalies; precipitated by acids; little soluble in water, more soluble in alcohol, without odor or taste; oxidized by HNO_3 to picric acid, appears to be the diuretic principle. (Stenhouse.)
Ononis spinosa. The root.	*Ononin*, $C_{62}H_{68}O_{27}$, colorless needles; inodorous; readily soluble in boiling water and alcohol; insoluble in ether; red with H_2SO_4; splits with caustic baryta into formic acid and *onospin*, $C_{60}H_{34}O_{25}$, which, with diluted H_2SO_4 or HCl, yields sugar and *ononetin*, $C_{48}H_{44}O_{13}$.
	Onocerin, $C_{12}H_{20}O$, another crystallizable principle, not altered by boiling, as above.
Rosaceæ.	
Geum urbanum. The root.	*Gein*, uncrystallizable, bitter; soluble in water, readily in alcohol and ether; with H_2SO_4 red, with HNO_3 yellow solution; forms with alkalies, lime, and lead, soluble compounds.
Quillaya saponaria (Quillaia bark).	*Saponin*, *see* Caryophyllaceæ.
Brayera anthelmintica (Kousso).	*Koussin*, white or yellowish; indistinctly crystalline; acrid; soluble in ether, alcohol, and alkalies; no glucoside. Anthelmintic in doses of 20 to 40 grs.
Granateæ.	*Punicin*, acrid, uncrystallizable, oily, powerful errhine.
Punica granatum. Granati rad. cort., *U. S.*	
Myrtaceæ.	*Caryophyllin*, $C_{10}H_{16}O$, yellow prisms, without taste or smell; soluble in ether and boiling alcohol.
Caryophyllus aromaticus.	
Caryophyllus, *U. S.* (The flower bud.)	*Eugenin*, $C_{10}H_{12}O_2$, yellow pearly scales, becomes red with HNO_3; isomeric with caryophyllic acid.
Cucurbitaceæ.	
Bryonia alba.	*Bryonin*, $C_{48}H_{80}O_{38}$, amorphous, very bitter, soluble in water and alcohol; insoluble in ether; splits into sugar, *bryoretin*, $C_{21}H_{35}O_7$, and hydrobryoretin, $C_{21}H_{37}O_8$.
	Bryonitin, crystals, soluble in alcohol, 95 per cent., and ether.
Citrullus colocynthis. Colocynthis, *U.S.* (The fruit.)	*Colocynthin*, $C_{56}H_{84}O_{23}$, amorphous, light-yellowish; insoluble in ether, soluble in water and alcohol; splits with acids into sugar and *colocynthein*, $C_{44}H_{64}O_{13}$.

* Coumarin also exists in Asperula odorata, *Rubiaceæ*, Anthoxanthum odoratum, *Gramineæ*, and some other herbs.

	Colocynthitin, obtained in white prisms from the part of the alcoholic extract insoluble in water and cold alcohol; soluble in hot alcohol and ether.
Cucumis prophetarum. The unripe fruit.	*Prophetin*, $C_{23}H_{36}O_7$, white resinous, little soluble in cold water, more in ether, very soluble in alcohol; intensely bitter; splits with acid into sugar and *propheretin*.
Momordica elaterium. Elaterium, *U. S.* (Squirting cucumber.)	*Elaterin*, $C_{20}H_{28}O_5$, colorless prisms, very bitter, acrid; insoluble in alkalies, dilute acids, and water; soluble in alcohol, little in ether; with H_2SO_4 red solution.
Umbelliferæ.	
Petroselinum sativum. The herb.	*Apiin*, $C_{24}H_{28}O_{13}$, white powder, tasteless; nearly insoluble in cold water; gelatinizing from hot solution; blood-red with $FeSO_4$.
	Apiol, yellowish, oily, non-volatile, acrid, pungent, heavier than water; soluble in alcohol, ether, chloroform.
Peucedanum officinale. The root.	*Peucedanin*, $C_{12}H_{12}O_3$, colorless rhombic prisms, without taste or odor; melts at 167° F.; insoluble in water, soluble in hot alcohol, ether, fixed and volatile oils. Splits into angelicic acid, $C_5H_8O_2$, and oreoselon, C_7H_4O.
Imperatoria ostruthium.	*Imperatorin*, identical with peucedanin.
Athamantum oreoselinum. The root.	*Athamantin*, $C_{24}H_{30}O_7$, colorless needles or prisms, peculiar rancid odor on heating, taste rancid, bitter, acrid; melts at 174° F.; splits into oreoselon, $C_{14}H_{10}O_3$, and valerianic acid, $C_5H_{10}O_2$.
Rubiaceæ.	
Cinchona calisaya and other species. The root bark and wood.	*Kinovin*, $C_{30}H_{48}O_8$, whitish, resinous, intensely bitter; little soluble in water, readily in alcohol and ether; soluble red in H_2SO_4. By gaseous HCl splits into *mannitan*, $C_6H_{12}O_{10}$, and *kinovic acid*, $C_{24}B_{38}O_4$, which is tasteless, but yields bitter salts. (*See* page 529.)
Compositæ.	
Achillea moschata. Iva herb of Switzerland.	*Ivain*, $C_{48}H_{42}O_6$, bitter, semi-fluid, yellow, insoluble in water, soluble in alcohol.
Arnica Montana.	*Arnicin*, $C_{24}H_{36}O_5$, golden-yellow mass, soluble in alkalies and in muriatic acid.
Artemisia absinthium. Absinthium, *U. S.* (The herb.)	*Absynthin*, $C_{20}H_{28}O_4+Aq$, granular crystalline; soluble in alcohol and ether, little in water; with KO, brown-red solution; H_2SO_4 greenish-blue solution, with little water deep blue.
Angelica archangelica. The root.	*Angelicin*, amorphous and crystalline; taste insipid, afterwards aromatic and burning.
Cnicus benedictus. Blessed thistle.	*Cnicin*, $C_{14}H_{18}O_5$, colorless needles; faintly bitter; fusible; little soluble in cold water and ether, easily in alcohol; with H_2SO_4 blood-red, HCl green; probably a glucoside.
Mikania Guaco. The leaves.	*Guacin*, yellowish, uncrystallizable, bitter; soluble in ether, alcohol, and boiling water.
Lactuca virosa. The juice.	*Lactucin*, $C_{11}H_{14}O_4$, white pearly scales, in the juice combined with lactucic acid; bitter; easily soluble in alcohol, scarcely in cold water and ether.
	Lactucone, $C_{40}H_{68}O_5$, white granules deposited from hot alcohol on cooling; insoluble in water, soluble in ether.
Lactuca sativa. Lettuce. The juice.	*Lactucopirin*, $C_{44}H_{64}O_{21}$, brown, amorphous, very bitter; faint acid reaction; readily soluble in water and alcohol; not precipitated by PbO salts.
Lactucarium, *U. S.*	
Leontodon taraxacum. Taraxacum, *U. S.* (The root.)	*Taraxacin*, colorless crystals, bitter, acrid, fusible; soluble in boiling water and alcohol. (Polex.)
Tanacetum vulgare. Tanacetum, *U. S.*, Tansy. (The flowers.)	*Tanacetin*, yellowish-white warts; very bitter; very soluble in ether, less in alcohol, slightly in water; with H_2SO_4 hyacinth-colored solution.

Caprifoliaceæ.	
Lonicera xylosteum. The berries.	*Xylostein*, crystalline, bitter principle; by dilute acids converted into sugar and other substances. (The seeds contain a volatile poison.)
Ericaceæ.	
Arctostaphylos uva ursi. Uva ursi, *U. S.* (The leaves.)	*Arbutin*, $C_{12}H_{16}O_7$, bitter, colorless crystals; soluble in boiling water and alcohol, slightly in ether; glucoside; a striking blue color with phospho-molybdic acid. (*See* page 530.) *Urson*, $C_{10}H_{17}O$, colorless, silky, tasteless, acicular crystals; insoluble in water, acids, and alkalies; fusible, sublimes unchanged, inflammable; orange-yellow with HNO_3.
Erica, Ledum, Arbutus, Rhododendron, etc. The leaves.	*Ericolin*, $C_{34}H_{56}O_{21}$, brown-yellow, extractive, intensely bitter; by H_2SO_4 into ericinol and sugar.
Oleaceæ.	
Vaccinium Vitis Idœa. Leaves of cowberry.	*Vacciniin*, one per cent. in the leaves, crystalline; very soluble in hot water, less so in cold water and alcohol, scarcely in ether; not precipitated by tannin nor by acetate of lead.
Olea Europæa (olive-tree). The gum.	*Olivil*, $C_{14}H_{18}O_5$, needles in starlike groups, bitter, and sweet taste; melt at 250°; soluble in water and boiling alcohol, easily in alkalies, slightly in ether; by very dilute HNO_3 red-yellow.
Plumeria lancifolia. A febrifuge bark from Brazil.	*Agonidine*, $C_{10}H_{14}O_4$, a glucoside, soluble in boiling water and alcohol, less so in ether.
Fraxinus excelsior. Common European ash. The bark.	*Fraxin*, $C_{32}H_{36}O_{20}$, yellowish needles, slightly bitter and astringent; soluble in boiling water and alcohol; fluorescent, but blue color disappearing on adding acids; splits with acids into *fraxetin*, $C_{10}H_8C_5$, and sugar; identical with paviin.
Ligustrum vulgare. Privet. The bark.	*Ligustrin*, identical with syringin. *Ligustropicrin*, analogous to syringopicrin. *Ligustron*, needles, sublimable with an aromatic odor; bitter; soluble in water, alcohol, and ether; reduces Ag from its solutions in NH_3.
Phillyria latifolia (a species of privet).	*Phillyrin*, $C_{27}H_{34}O_{11}$. Crystalline, nearly tasteless, soluble in hot water and alcohol, insoluble in ether. By diluted HCl forms sugar and *phillygenin*, $C_{21}H_{24}O_6$, which is polymeric with saligenin. Reputed antiperiodic.
Syringa vulgaris. Lilac. The bark.	*Syringin*, $C_{19}H_{28}O_{10}$. Colorless needles; tasteless; soluble in water, more in alcohol, not in ether. The solutions in H_2SO_4 deep blue or violet; splits with acids into sugar and *syringenin*, $C_{13}H_{13}O_5$. *Syringopicrin*, in all parts of lilac; amorphous, yellowish-white; bitter; slight acid reaction; readily soluble in water and alcohol; insoluble in ether; precipitated by tannin.
Apocynaceæ.	
Apocynum cannabinum, *U. S.*	*Apocynin*, peculiar active principle.
Asclepiadeæ.	
Asclepias Syriaca. The milky juice.	*Asclepion*, $C_{20}H_{34}O_3$, white crystalline mass, odorless, tasteless; insoluble in water and alcohol, soluble in ether.
Asclepias vincetoxicum. The root.	*Asclepin*, pale yellow; readily soluble in water and alcohol; emetic, precipitated by tannin, $HgCl_2$, and subacetate of lead.
Gentianeæ.	
Gentiana lutea. Gentiana, *U. S.* (The root.)	*Gentiopicrin*, $C_{20}H_{30}O_{12}$. Extracted from the aqueous infusion by animal charcoal; crystallizable; readily soluble in water and alcohol, insoluble in ether; not precipitated by $\overline{Tan}$ or $2PbO,\overline{Ac}$. Splits with acids into sugar and *gentiogenin*, a brownish-yellow, amorphous body.

Menyanthes trifoliata. Herb. (Buck-bean.)	*Menyanthin*, $C_{33}H_{54}O_{16}$, whitish, amorphous, bitter; soluble in alcohol and water, not in ether; with H_2SO_4 sugar and a volatile oil, menyanthol.
Ophelia Chirayta. Herb.	*Chiretin*, $C_{26}H_{48}O_{15}$, very bitter; neutral; precipitated by tannin, by the action of acids separated into ophelic acid and chiratogenin, $C_{13}H_{24}O_3$.
Elythiæ chilensis. European centaury.	*Erythro centaurin*, white and crystalline, becoming red on exposure to the sun's rays; existing in minute quantity; poisonous; soluble in ether, and fuses at 136° C.
Sabbatia angalaris. American centaury.	
Convolvulaceæ.	
Ipomœa jalapa.* Jalapa, *U. S.* (The rhizoma.)	*Convolvulin*, $C_{31}H_{50}O_{16}$, white or transparent; inodorous and tasteless; insoluble in ether and water, soluble in alcohol and acetic acid; resinous; by H_2SO_4 amaranth-red. (*See* page 530.)
Ipomœa Orizabensis. False jalap. Jalap stalk.	*Jalapin*, $C_{34}H_{56}O_{16}$, white, amorphous, resinous; readily soluble in alcohol and ether, wood-spirit, benzol, oil of turpentine and acetic acid; by H_2SO_4 amaranth-red. (*See* page 530.)
Convolvulus scammonia. Scammonium, *U. S.* (The concrete juice.)	*Scammonin*, identical with jalapin. (Spirgatis.)
Ipomœa simulans. Tampico jalap.	*Tampicin*, $C_{34}H_{54}O_{14}$, fusible at 130° C., but begins to decompose at 100° C.; soluble in acetic acid and in ether.
Solaneæ.	
Capsicum annuum, and other species. The fruit.	*Capsicin*, white tufts of crystals; soluble in alcohol and ether. (*See* page 531.)
Parisquadrifolia. The herb.	*Paridin*, $C_6H_{12}O_4$, colorless shining scales or needles, bitterish, acrid; little soluble in cold water and ether, freely in alcohol; by H_2SO_4 and HPO_4 red.
Physalis alkekengi. The leaves of the winter cherry.	*Physalin*, $C_{14}H_{16}O_5$, bitter, amorphous, yellowish; soluble in alcohol, chloroform, and ammonia.
Scrophularineæ.	
Digitalis purpurea. (The leaves.)	*Digitalin*, or *digitasolin*, $C_{27}H_{45}O_{15}$, light straw-yellow; amorphous, granular from the alcoholic solution; very bitter; irritating to the nostrils; soluble in 125 p. cold, in 42 p. boiling water; scarcely soluble in ether, more in alcohol; brown and purple in H_2SO_4, green in HCl, rose-red and brown in NH_3; splits with acids into sugar, *digitaliretin*, $C_{15}H_{25}O_5$, and *paradigitaliretin*, $C_{22}H_{34}O_5$. *Digitaletin*, *Delffi digitalin*, $C_{21}H_{33}O_9$ (digitalin minus $C_6H_{12}O_6$), white warty crystals, insoluble in ether and cold water, soluble in 222 p. boiling water; without coloration in NH_3 and HCl; splits into sugar and digitaliretin. *Digitalarin*, golden-yellow, resinous, very acrid, soluble in ether and NH_3; in the pure state pearly-white microscopic prisms, $C_{11}H_{22}O_2$.
Gratiola officinalis. Hedge hyssop.	*Gratiolin*, $C_{20}H_{34}O_7$, bitter, white, crystalline, soluble in boiling water and alcohol; insoluble in ether; splits into sugar, *gratiolaretin*, $C_{17}H_{28}O_3$, and *gratioletin*, $C_{17}H_{28}O_8$. *Gratiosolin*, $C_{46}H_{84}O_{25}$, amorphous, yellow; insoluble in ether, soluble in water and alcohol. Products of decomposition numerous. (See *Am. Journ. Ph.*, 1859, 341.)
Scrophularia nodosa. The herb.	*Scrophularin*, crystalline scales, bitter, soluble in water.

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* Ipomœa jalapa, *Nuttall;* Ipomœa Schiedeana, *Zuccarini;* Ipomœa purga, *Schlechtendal;* Convolvulus jalapa, *Schiede;* Convolvulus purga, *Wenderoth;* Convolvulus officinalis, *Pelletan;* Exogonium purga, *Bentham;* are all synonyms for true jalap.

Labiatæ.	
Rhinanthus Alextorolophus.	*Rhinanthus*, $C_{88}H_{52}O_{40}$, a glucoside, in stellate prisms, bitterish-sweet taste, soluble in water and alcohol; intense greenish-blue when heated with muriatic acid.
Marrubium vulgare. Horehound. The leaves.	*Marrubiin*, crystallizes from ether and alcohol; little soluble in water; intensely bitter, afterwards acrid; with H_2SO_4 brown-yellow solution; not precipitated by tannin.
Lycopus Europæus. Bugle weed.	*Lycopin*, pale yellowish; hard; very bitter; soluble in water, easily in alcohol and ether; insoluble in alkalies.
Teucrium scordium. Germander.	*Scordiin*, yellow gum-like or white powder; agreeably aromatic and bitter; insoluble in cold water, soluble in alcohol and ether; red-brown in H_2SO_4, yellow in alkalies.
Primulaceæ.	
Cyclamen Europæum. Primula officinalis. Cowslip primrose.	*Cyclamin*, $C_{20}H_{24}O_{10}$, *Arthanatin of Saladin*, white, amorphous or crystalline, inodorous; hygroscopic, light brown; gelatinizes with cold water, afterwards soluble, frothing; coagulated above 140°, but redissolving on standing; soluble in alcohol and acetic acid; insoluble in ether; acrid poison; splits with emulsin into sugar and cyclamiretin, $C_{14}H_{16}O_6$. (See *Amer. Journ. Pharm.*, 1860, p. 155.)
Thymelæ.	
Daphne mezereum. Mezereum, *U. S.* (The bark.)	*Daphnin*, $C_{31}H_{34}O_{19}+4H_2O$, brilliant colorless prisms, soluble in boiling water and alcohol; insoluble in ether; bitter, astringent, inodorous; splits with acids into sugar and daphnetin, $C_{19}H_{14}O_9$. (See *Am. Journ. Pharm.*, 1861, p. 325.)
	Coccogenin, $C_{20}H_{22}O_8$, needle-shaped, silky crystals, soluble in alcohol and hot water, insoluble in ether and cold water.
Laurineæ.	
Laurus nobilis. The leaves.	*Laurin*, $C_{32}H_{30}O_3$, white prisms, odorless; taste acrid and bitter; insoluble in water; soluble in hot alcohol and ether.
Aristolocheæ.	
Aristolochia clematitis.	*Clematitin*, $C_{18}H_5O_{12}$, is extracted by boiling water; uncrystallizable.
Aristolochia serpentaria, Serpentaria, *U. S.* (The root.)	*Serpentariin*, uncrystallizable, bitter, and acrid; soluble in water and alcohol.
Asarum Europæum.	*Asarin*, yellowish-brown, amorphous, disagreeably bitter, emetic; soluble in water and alcohol; precipitated by tannin.
Euphorbiaceæ.	
Croton eleuteria, Cascarilla, *U. S.* (The bark.)	*Cascarillin*, white crystals, bitter, inodorous; slightly soluble in water, readily in alcohol and ether; with H_2SO_4 deep red, with HCl violet solution.
Croton tiglium, Oleum tiglii, *U. S.* (The oil.)	*Crotonol*, $C_9H_{14}O_2$, colorless oil; soluble in alcohol and ether; decomposed by alkalies and boiling water; very blistering.
Urticeæ.	
Humulus lupulus. (Strobiles.)	*Humulin* (impure?), amorphous, bitter, yellow, inodorous; little soluble in ether, soluble in alcohol, and in 200 parts boiling water.
Plumbaginaceæ.	
Plumbago Europæa. Leadwort. The root.	*Plumbagin*, from the aqueous decoction of the ethereal extract, reddish-yellow scales; taste sweetish, sharp, and burning; soluble in hot water, alcohol, and ether; with PbO carmine-red compound.
Datisca cannabina. Leaves and root.	*Datiscin*, $C_{21}H_{22}O_{12}$, colorless, silky needles or scales; easily soluble in alcohol, less in ether and cold water; very bitter, fusible; soluble in alkalies with yellow color, precipitated by acids; by H_2SO_4 forms sugar and *datiscetin*, $C_{15}H_{10}O_6$.
Cupuliferæ.	
Quercus Robur. The old bark.	*Quercin*, small white crystals, very bitter; soluble in water, acetic acid, and diluted alkalies; insoluble in absolute alcohol, ether, and volatile oils; by H_2SO_4 orange.

Juglandeæ.

Juglans Regia. Common Walnut.

Regianin, elongated octohedrons or needles, but little soluble in water, more soluble in alcohol and benzole; changes into a black amorphous acid, forming purple salts with the alkalies.

Betulaceæ.

Betula lenta. Sweet birch. The bark.

Gaultherin, in the alcoholic extract; appears to be a copulated compound; with acids, or the aqueous infusion of the bark, yields oil of gaultheria.

Salicaceæ.

Populus tremula. Bark and leaves of the aspen.

Populin, $C_{20}H_{22}O_8+2H_2O$, white crystalline powder, sweetish and acrid taste; soluble in alcohol, slightly in water; by boiling with alkali forms salicin and benzoic acid.

Salix and Populus, several species. The bark.

Salicin, $C_{13}H_{18}O_7$, white scales or prisms, very bitter; soluble in water and alcohol; insoluble in ether and volatile oils. (*See* page 531.)

Piperaceæ.

Piper cubeba. Cubeba, *U. S.* (The berries.)

Cubebin, $C_{17}H_{34}O_5$, white, crystalline, inodorous, insipid, not volatilizable by heat, cryst. from alcohol; nearly insoluble in water, soluble in ether, acetic acid, fixed and volatile oils; with H_2SO_4 carmine-red; deposited in oleoresina cubebæ.

Coniferæ.

Pinus sylvestris and Thuja occidentalis. The leaves or bark.

Pinipicrin, $C_{22}H_{56}O_{22}$, bitter, amorphous, light yellowish-brown; soluble in water and alcohol, insoluble in ether, liquid at 212°; with dilute H_2SO_4 a volatile oil, ericinol, $C_{10}H_{16}O$, and sugar.

Zingiberaceæ.

Curcuma longa.

Curcumin, $C_{10}H_{10}O_3$, orthorhombic crystals; yellow-colored, fusible at 172°.

Orchideæ.

Vanilla aromatica. Prepared unripe capsule.

Vanillin, $C_{10}H_6O_2$, colorless, four-sided needles, strong vanilla odor, hot biting taste. (*See* page 533.)

Amaryllidaceæ.

Narcissus pseudo-narcissus, N. poeticus and N. Tazetta.

Narcitin, white, uncrystallizable; faint odor and taste; emetic; soluble in water, alcohol, and acids.

Smilaceæ.

Smilax officinalis and other species. The root.

Sarsaparilla, *U. S.*

Smilacin, $C_{12}H_{34}O_{14}$, *sarsaparillin*, *pariglin*, *salsaparin*, *parillic acid*; colorless needles or scales; disagreeable, bitter, acrid, nauseous taste; soluble in boiling water, alcohol, and ether, froths in solution, similar to *saponin*; H_2SO_4 deep violet; is a glucoside.

Asparagus communis. The berries.

Spargancine, a yellowish-red pigment, soluble in alcohol and ether; also *spargine*, a peculiar bitter principle.

Liliaceæ.

Inspissated juice of Aloe socotrina and other species. Aloes.

Alöin, $C_{34}H_{36}O_{14}+Aq$, sulphur-yellow crystals, intensely bitter; soluble in cold water, alcohol, and alkalies; insoluble in ether, chloroform, benzin, and volatile oils; by H_2SO_4 and HNO_3 red; becomes amorphous below 200°. (*See* page 533.)

Convallaria majalis. Lily of the valley, herb and root.

Convallarin, $C_{34}H_{62}O_{11}$, colorless prisms; acrid taste; little soluble in water, the solution frothing; readily soluble in alcohol and ammonia; insoluble in ether; splits by acids into sugar and *convallaretin*, $C_{28}H_{52}O_6$.

Convallamarin, $C_{23}H_{44}O_{12}$, white powder; bitter and sweetish; soluble in water, ammonia, and alcohol; insoluble in ether; by H_2SO_4 violet; splits by acids into sugar and convallamaretin, $C_{20}H_{36}O_8$.

Polygonatum multiflorum. The herb.

The crystallizable principle resembles and is probably identical with *paridin* (Walz).

Scilla maritima. The bulb. Scilla, *U. S.*

Scillitin, bitter needles; insoluble in water; soluble in alcohol and ether; decomposed by alkalies; emetic, cathartic, and narcotic poison. (Bley.) Mandet has separated

Skuleine, an irritating poison, and

Scillitine, the diuretic and expectorant principle. No process published.

Lycopodiaceæ. Lycopodium chamæcy parissus. The herb.	*Lycopodin*, colorless needles; very soluble in water, alcohol, and ether, probably a glucoside.
Lichenes. Variolaria amara.	*Picrolichenin*, $C_6H_5O_2$, small, brilliant, rhombic, pyramidal crystals; very bitter, and said to be febrifuge; soluble in alcohol, ether, volatile and fixed oils, H_2SO_4 and $\overline{Ac}$; scarcely in water.
Parmelia physodes.	*Ceratophyllin*, white needles, fusible at 296° F.; taste slightly acrid; soluble in alcohol and boiling soda solution; purple with little Fe_2Cl_3; blood-red with chlorinated lime.
Fungi. Boletus laricis (agaric).	*Laricin*, red-brown, bitter resin; odor sweetish; soluble in ether, alcohol, acetic acid, and alkalies; insoluble in oil of turpentine.

2. *Quaternary or Nitrogenized Neutral Principles.*

Rosaceæ. The kernels, leaves, and flowers of many plants.	*Amygdalin*, $C_{20}H_{27}NO_{11} + 3H_2O$, white scales or prisms, inodorous, agreeably bitter; soluble in water and alcohol; insoluble in ether. (*See* page 532.) *Emulsin.* The peculiar vegetable albumen of this species of plants is a protein compound. (*See* page 351.)
Leguminosæ. Also in malvaceæ and asparageæ. (Young beans, peas, asparagus, beets, liquorice root, etc.)	*Asparagin, althœin*, or *malamid*, $C_4H_8N_2O_3H_2O$, octohedrons, colorless, inodorous, insipid; insoluble in ether; soluble in 58 parts water and less alcohol, by fermentation owing to impurities converted into succinate of ammonia, thus:— $N_2C_4H_8O_3 + H_2O = 2NH_2,C_4H_6O_4$.

3. *Sulphuretted Neutral Principles.*

Cruciferæ. Sinapis alba. The seed.	*Sulpho-sinapisin*, $C_{16}H_{23}NO_5H_2SO_4 + 2H_2O$, crystallizable; by the action of a ferment contained in the seed, converted into an acrid bitter principle; by alkalies, into sinapic acid, sinkalina, a very strong base, and hydro-sulphocyanic acid; by acids, sinapina, $C_{16}H_{23}NO_5$.

4. *Animal Neutral Principles.*

Cantharis vesicatoria. Cantharis, *U. S.* Cantharis vittata, *U. S.*, and other species.	*Cantharidin*, $C_5H_6O_2$, prepared by the evaporation of ethereal or chloroformic tincture of flies; crystallized from boiling alcohol; white scaly micaceous crystals, without odor or taste; when pure insoluble in water, slightly soluble in cold alcohol, soluble in ether, chloroform, benzole, fixed oils, etc., fusible and volatile; soluble in water in its natural state of combination. A powerful vesicant.
Castor fiber. (Peculiar concrete substance.) Castoreum, *U. S.*	*Castorin*, crystallizes from the boiling alcoholic tincture, purified by washing with cold alcohol; long fasciculated prisms, odor of castor, cuprous taste, insoluble in cold water and alcohol, soluble in volatile oils and 100 parts of boiling alcohol; Canadian castor contains 7 per cent.
Fresh meat. Chickens, game, etc.	Creatine, $C_4H_9N_3O_2 + H_2O$. (*See* page 518.)

REMARKS ON SOME OF THE NEUTRAL PRINCIPLES.

Æsculin, or Polychrom, is found besides in the bark of the horse-chestnut tree, also in quassia wood and red saunders.

The bark is exhausted by alcohol of eighty per cent., slightly evaporated and set aside for several weeks, the powder washed with

ice-cold water, and recrystallized from a boiling mixture of one part of ether and five of alcohol.

A very dilute solution, containing one-millionth part, opalesces with blue color in reflected light; acids destroy this property, alkalies restore it, chlorine destroys it, coloring the solution red.

By the action of diluted acids it is converted into sugar and *æsculetin*. $C_{15}H_{10}O_9 + H_2O = C_9H_6O_4 + C_6H_{12}O_6$.

Paviin may be obtained by the slow evaporation of the ethereal tincture in needles grown in star-like groups.

Its properties are similar to *æsculin*, but, while this fluoresces with sky-blue color, paviin shows a green color in solution; both usually occur together in the barks of this family; the genus *æsculus* containing *æsculin*, the genus *pavia*, *paviin*, in preponderance.

These principles, though little known except as scientific curiosities, are worthy a trial as antiperiodics. The bark has long been reputed to possess febrifuge properties.

Quassin, the active principle of the intensely bitter wood and barks of the quassias, is best prepared by the following process:—

The decoction is precipitated by milk of lime, the filtrate evaporated, the residue dissolved in alcohol, treated with animal charcoal, evaporated and recrystallized from water. 8 lbs. quassia wood yield 1 drachm.

In Martinique and other neighboring islands, the wood of Bytteria febrifuga, *Simarubeæ*, there called false simaruba, is employed for intermittents. Gerardias found its bitter principle to be quassin, of which it contains a much larger proportion than does quassia.

Colocynthin.—The fruit of colocynth, in fine powder, is mixed with and packed upon animal charcoal, displaced with alcohol, and evaporated spontaneously; a garnet-colored, pulverizable mass, extremely bitter, soluble in water and alcohol, insoluble in ether, remains behind.

Active cathartic in the dose of one and a half grain.

It is obtained pure by treating the aqueous solution of the alcoholic extract successively with subacetate of lead, sulphuretted hydrogen and tannin; the last precipitate, after dissolving in alcohol, is again treated with lead and sulphuretted hydrogen; the filtrate is evaporated spontaneously, the residue is well washed with anhydrous ether. (Walz.)

Kinovin (formerly erroneously called kinovic acid) was first discovered in the so-called *quinquina nova*, but afterwards separated from the officinal Peruvian barks. De Vrij found the following quantities in species of cinchona, cultivated in Java: *Cinchona calisaya*, wood of the root 2.57; bark of the root 1.08; wood 1.80; bark of trunk .359; bark of main branches .690; green branches .849; dry leaves .230. *Cinch. lucumæfolia*, wood 1.280; bark of trunk .420 per cent.

It is prepared by exhausting the cinchona barks with boiling water (the bases, kinic and cincho-tannic acids are removed), afterwards with boiling milk of lime (cinchona red remains behind). The filtrate is supersaturated by HCl, and the precipitate purified

by again combining with CaO, decolorizing by animal charcoal, and precipitating by HCl.

Or the bark is boiled with very dilute NaO or KO, the filtrate saturated by HCl, and the precipitate freed from cinchona red by CaO and treating as before. It is freed from adhering kinovic acid by dilute alcohol or chloroform, which leave the latter insoluble.

Arbutin.—An aqueous decoction, is precipitated by acetate of lead, and the filtrate, after treating with HS, evaporated to a syrupy consistence; after some time, prisms of *arbutin* appear. By emulsin or H_2SO_4 it is decomposed into sugar and *hydrokinone*. $C_{12}H_{16}O_7 + H_2O = C_6H_{12}O_6 + C_6H_6O_2$.

Ursin.—The alcoholic solution of the aqueous extract of uva ursi is repeatedly treated with animal charcoal, and evaporated spontaneously.

Colorless needles, soluble in alcohol, water, ether, and dilute acids; neutral reaction. In the dose of one grain, this appears to be powerfully diuretic.

The resinoid principles of jalap have already been treated of in their practical relations among the concentrated or resinous extracts; in this connection it will be proper to refer to them as the neutral principles giving activity to that particular family of plants.

Convolvulin, formerly called Rhodeoretin.—The tuberous root of Convolvulus Schiedeanus (Ipomœa Jalapa), after exhausting it with boiling water, is exhausted with 90 per cent. alcohol, water is added until precipitation commences, it is filtered hot through animal charcoal, evaporated, exhausted with ether, the residue dissolved in alcohol, and precipitated by ether.

Its solution in alkalies contains convolvulic acid $= C_{31}H_{50}O_{16}$; it is soluble in water, and is therefore not precipitated by water.

Convolvulin, dissolved in anhydrous alcohol, and treated with hydrochloric acid, is decomposed into an oily, crystallizing body, *convolvulinol* and sugar.

Convolvulic acid, in aqueous solution, treated with dilute H_2SO_4 suffers the same decomposition. Convolvulinol, $C_{26}H_{50}O_7$, separated from its alkaline solution, has been converted into *convolvulinolic acid*, $C_{26}H_{46}O_5$.

The above three substances are converted by HNO_3 into *ipomic acid*, $HO,C_{10}H_{16}O_3H_2O$.

Jalapin.—The root of Ipomœa Orizabensis, after exhaustion with boiling water, is treated with alcohol, water added until turbidity commences, boiled with fresh animal charcoal, filtered, precipitated with acetate of lead and a little ammonia, the filtrate treated with sulphuretted hydrogen, distilled, the resin treated with boiling water, and dissolved in ether.

Its solution in alkalies and alkaline earths contains jalapic acid $= C_{34}H_{56}O_{16} + Aq$, which is tribasic. Mineral acids decompose jalapin and jalapic acid into sugar and *jalapinol* (white crystalline) $= C_{32}H_{62}O_7$. Separated from its combinations with alkalies, it has been converted into *jalapinolic acid*, $= C_{32}H_{40}O_5$.

Jalapin, jalapic, and jalapinolic acid, treated with HNO_3, are converted into oxalic and ipomic acid, $C_{10}H_{16}O_3H_2O$.

Scammonin.—By numerous investigations it was proved that this resinous principle was very analogous to the two preceding, until Spirgatis proved its identity with the cathartic principle of the so-called jalap stalks, the root of Convol. Orizabensis, and that all differences previously observed are due to impurities obstinately adhering to it.

It must be remembered that the pure resin of the officinal jalap, which by pharmacists is frequently called jalapin, is the convolvulin of chemists, while jalapin of chemists is produced from an unofficinal plant and is identical, while the former is only homologous with scammonin.

Capsicin.—In the winter of 1856 and '7, one of my pupils, H. B. Taylor, of Philadelphia, being about to prepare his thesis for the Philadelphia College of Pharmacy, pursued a course of experiments upon Capsicum annuum, under my direction, which resulted in the discovery of a crystalline principle, which appears to be the true capsicin, though that name had before been applied to oily or soft resinoid products. The process was as follows: Powdered capsicum was treated with anhydrous ether and evaporated, the oleo-resinous product was digested in alcohol of .809 sp. gr., the filtered alcoholic solution was treated with subacetate of lead, which threw down a copious precipitate; this was separated by filtration, and the clear tincture treated with sulphhydric acid; the precipitated sulphuret of lead was now removed, the solution boiled, again filtered, evaporated, and set aside, on an intensely cold day, to crystallize. On examination, the whole was found to have solidified into a mass of beautiful, nearly white, feathery crystals. Owing to the comparative insolubility of sulphhydric acid gas in alcohol, they were not completely free from lead salt, and were further purified and crystallized, though not with the same facility, from the change of temperature. These crystals seem analogous to a stearoptene; heated, they first melt, and then take fire, burning with a bright rose-colored flame, and giving off dense, suffocating fumes; heated with sulphuric acid, they blacken, and give off white fumes. The taste is excessively fiery, inflaming all parts with which it comes in contact; the odor is faint. The crystalline sediment which is separated during the spontaneous evaporation of the ethereal tincture of capsicum is probably the same compound.

Digitalin.—The leaves of digitalis contain several neutral principles which are closely allied to each other, are present in commercial digitalin, and are obtained, according to Walz, by one process. The aqueous solution of the alcoholic extract is treated with PbO, the filtrate freed from lead by H_2SO_4, neutralized by NH_3, and precipitated by tannin. The precipitate is rubbed together with PbO or subacetate of lead and repeatedly boiled with alcohol; the filtrate is treated with H_2S and evaporated. The yellowish-white residue is crude digitalin, from which pure ether dissolves *digitalacrin;* water leaves *digitaletin* and dissolves *digitalin*, which is obtained

pure by treatment with tannin, lead, etc., as before. Digitalin is a powerful poison, given for the same sedative properties as the leaves. It has lately been much prescribed in the form of granules of sugar, which have been saturated with the tincture, so that each shall represent a given quantity of the medicine. The usual dose is one-thirtieth of a grain. Being among the most powerful of known poisons, it should be used with great care. Kosmann gives to digitalin the formula $C_{47}H_{45}O_{15}$.

Salicin.—The bark of the following plants contains no salicin: S. alba, Babylonica, bicolor, capræa, daphnoides, incana, fragilis, Russeliana, triandra, viminalis and Populus angulosa, fastigiata, grandiculata, monilifera, nigra, Virginica; all the other willows contain salicin, and it is probable that all the herbaceous kinds of spiræa, which yield salicylous acid (oil of spiræa), contain it originally.

To prepare it the decoction of willow bark is evaporated to three times the weight of the bark employed, digested with oxide of lead, and the filtrate evaporated to syrupy consistence. After several days the crystals are separated and purified by recrystallization. (Duflos.)

Concentrated H_2SO_4 colors it blood-red; water decolorizes it again, dissolving a peculiar acid (rufisulphuric acid). Cold diluted H_2SO_4 or HCl converts it into sugar and *saligenin.* $C_{13}H_{18}O_7 + H_2O = C_6H_{12}O_6 + C_7H_8O_2$ = saligenin.

If treated hot, it is converted into sugar and *saliretin.* $2C_{13}H_{17}O_7 = 2C_6H_{12}O_6 + C_{14}H_{10}O_2$ = saliretin.

Cold HNO_3 of 1.16 specific gravity converts it into *helicin.* $C_{13}H_{18}O_7 + O = O_{13}H_{16}O_7 + H_2O$ = helicin.

If a more diluted HNO_3, of 1.09 specific gravity, is used, the result is a compound between helicin and salicin, which has been called *helicoidin.* $2C_{13}H_{18}O_7 + O = C_{13}H_{16}O_6 + H_2O$ = helicoidin.

If salicin is heated with very dilute HNO_3, just to the boiling point, and allowed to cool, or evaporated at a low temperature, salicylous acid is separated.

At the boiling point, nitrosalicylic acid is formed, and by continued influence picric and óxalic acids.

Melted with an excess of caustic potassa, it is converted into salicylate and oxalate of potassium.

Heated with binoxide of lead, formiate of lead is obtained; with black oxide of manganese and dilute H_2SO_4, formic and carbonic acids; with bichromate of potassium and H_2SO_4, carbonic, formic, and salicylous acids.

By dry distillation it yields, among pyro products, salicylous acid; and when taken internally it is found in the urine together with its products of decomposition—saligenin, salicylous and salicylic acids.

Saligenin, $C_7H_8O_2$, pearly crystals, easily soluble in boiling water, alcohol, and ether, sublimes above 212°; colored red by concentrated H_2SO_4; concentrated HNO_3 oxidizes it to picric, diluted HNO_3 to salicylous and nitrosalicylous acids, $C_7H_8O_2 + 2O = C_7H_6O_3$

$+H_2O$; heated with hydrate of potassa, it is converted into salicylic acid and hydrogen, $C_7H_8O_2+KOH_2O=C_7H_5KO_3+H_2O+H_3$. Sesquisalts of iron impart an indigo-blue color. Dilute acids by boiling convert it into

Saliretin, $C_{14}H_{14}O_3=2C_7H_6O_2+H_2O$, which is insoluble in water and ammonia, soluble in alcohol, ether, concentrated acetic acid, and fixed alkalies; concentrated H_2SO_4 colors it blood-red; concentrated HNO_3 oxidizes it on boiling to picric, not to oxalic acid.

Helicin, $C_{13}H_{16}O_7$, white needles, without odor, bitterish taste, insoluble in ether, easily soluble in hot water and alcohol. By synaptase and boiling with alkalies it is converted into sugar and salicylous acid, $C_{13}H_{16}O_7+H_2O=C_6H_{12}O_6+C_7H_6O_2$.

Helicoidin is a derivative, having the composition $C_{26}H_{34}O_{14}=C_{13}H_{16}O_7$ (helicin)$+C_{13}H_{18}O_7$ (salicin). By synaptase is decomposed into sugar, saligenin, and salicylous acid.

Salicin was formerly used to adulterate sulphate of quinia, which it resembles in appearance. It is tonic and febrifuge, though little used. Dose, three to thirty grains.

Vanillin.—Vanilla of commerce is exhausted with alcohol, evaporated to an extract, this exhausted by ether, which is to be evaporated, heated with boiling water, which, on evaporation, lets fall the principle; recrystallized and treated with animal charcoal, it is obtained in colorless four-sided needles, of strong vanilla odor, hot, burning taste; fuses at 195°, volatilizes at 302°; little soluble in cold water, very soluble in hot water, alcohol, ether, and the fixed and volatile oils. Concentrated H_2SO_4 dissolves it with yellow color; solution of potassa dissolves it and deposits it again on being neutralized.

The crystals observed on the surface of the fresh bean of commerce are found to consist of vanillin, not benzoic acid, as heretofore supposed.

Alöin.—This interesting proximate constituent of aloes has been prepared from several commercial varieties, especially from Barbadoes and Socotrine aloes. It was introduced into medicine by T. & H. Smith, of Edinburgh, who are still its principal manufacturers, and it has recently attained commercial as well as scientific interest from being pretty extensively prescribed as a mild and pleasant cathartic. Crystals of alöin have been observed in abundance in a variety of Socotrine aloes of semifluid consistence from the evaporation not having been carried as far as usual.

Preparation according to Groves.—Aloes is exhausted by boiling water, the decoction acidulated with muriatic acid, filtered, evaporated to a syrupy consistence, and set aside in a cool place to crystallize. The crystals, after a fortnight, are separated and purified by recrystallization from boiling water. Socotrine aloes yields 10 per cent. alöin. These crystals are to be dried by bibulous paper at a moderate heat; when thoroughly dry alöin is permanent in the air, but with moisture and heat conjoined, has a tendency to lose its crystalline form, assuming the amorphous character of aloes. (See *Proc. Am. Pharm. Assoc.*, 1860, p. 162.)

Its purgative properties have been denied, but the experience of numerous practitioners here and in Europe confirms its utility as a mild though pretty certain cathartic in doses of from two to three grains. (*See* Extemporaneous Pharmacy.)

Amygdalin.—This interesting principle is obtained from bitter almonds by the following process: Bitter almonds, powdered and expressed, to free them from fixed oil, are to be boiled in successive portions of alcohol till exhausted. The liquors thus obtained are placed in a still, and evaporated at a low heat, the alcohol being recovered. The syrupy residue is then to be diluted with water and mixed with yeast, and subjected to fermentation to separate sugar. Again evaporate, at a moderate temperature, to the consistence of syrup, cool, and add 95 per cent. alcohol. The amygdalin will then precipitate, and may be collected on a strainer; it is then to be purified by repeated resolution in hot alcohol, and crystallization. Any oil it may contain may be separated by shaking the solution with ether before or after the fermentation. One pound of almonds yields at least two drachms of amygdalin. Heat decomposes it, giving off the odor of hawthorn; heated with alkaline solutions, it evolves ammonia and forms amygdalic acid.

Amygdalin seems destitute of active properties, except when mixed in solution with *emulsin* (*see* Protein Compounds), producing grape sugar, oil of bitter almonds, and hydrocyanic acid, which is thus explained: $C_{20}H_{27}NO_{11}+2H_2O=2C_6H_{12}O_6+C_7H_6O+HNC$.

On the Decomposition of Organic Bodies.

On the foregoing pages the organic compounds have been treated of, and a number of pharmaceutical preparations derived from the organic kingdom. It is well known that such chemical and pharmaceutical compounds are subject to alterations by various influences, the study of which forms a most important part of chemistry. To many of these changes attention has been drawn in the appropriate places, and it remains now, without treating of the same in detail, to present them in a condensed form, conveniently arranged.

The decomposition of organic bodies may be treated of under four separate heads:—

I. *Oxidation by the Atmosphere.*—As a general rule, pure chemical compounds are not affected by dry or moist atmosphere, except perhaps to deliquesce or effloresce, or, like the salts of some volatile organic acids, as acetic and valerianic, to evolve them in moist air. But oxidation is comparatively rare, and mostly met with in compounds destitute of oxygen and abounding in hydrogen; examples are the ternary alkaloids and the carbo-hydrogens of the volatile oils.

The influence of ozone, the peculiar active form of oxygen, discovered by Schonbein, and described on page 131, in promoting the organic changes which take place among organic principles, has not yet been fully investigated. It is undoubtedly a potent agent

in those important metamorphoses, the study of which constitutes the branch of Organic Chemistry.

II. *Decomposition into Simpler Compounds.*—1. *By air and water.* Complex organic bodies are subject to oxidation and ultimately break up into the organic compounds carbonic acid, ammonia, and water; if this process of decomposition takes place slowly, it is called *decay;* if rapidly in the presence of more water and with the evolution of an offensive smell, *putrefaction;* under similar circumstances, when the product is a useful compound, *fermentation;* of this last a distinction is made between *vinous* fermentation (see page 362) and *acid* fermentation, the latter being again subdivided in accordance with the acid obtained, and is then called acetic, lactic, butyric, succinic, etc. (see the acids named); the presence of a nitrogenated compound is necessary, to act as a ferment.

2. *By acids.* Of the concentrated acids, the action of sulphuric acid is the most violent: it abstracts water from nearly all organic compounds, leaving a compound with a larger amount of carbon; or the carbon is oxidized, and the evolved gases contain carbonic oxide, and formic, carbonic, and sulphurous acids; compounds containing amide (NH_2) yield ammonia. Glacial phosphoric and arsenic acids have a similar action, but weaker.

Diluted acids act differently; they cause the combination with the elements of water (conversion of starch into sugar, p. 335), very seldom evolve carbonic acid (conversion of meconic into komenic acid), but very often decompose organic bodies into glucose and another compound of different behavior (*see* Tannic Acids, Salicin, etc.); the latter decomposition often takes place also by the influence of emulsin, synaptase, or similar ferments. (*See also* Glucosides, p. 347, and Copulated Compounds, p. 519.)

3. *By chloride of zinc.* Aided by heat, this is capable of abstracting water from organic compounds; it produces ether from alcohol, etc.

4. *By heat.* Organic compounds are called volatile if they may be distilled without suffering decomposition; others are decomposed, and the process is then termed *dry* or *destructive distillation*, and the products *pyro products.* These are, in the commencement of the distillation, highly oxygenated and of an acid nature, afterwards contain less oxygen, and at last are carbo-hydrogens (marsh gas, CH_3H, olefiant gas, C_2H_4) or ternary alkaloids (*see* Artificial Alkaloids); water, tar, and charcoal generally accompany the products of the dry distillation of all complex bodies. Exposure to a continued red or white heat resolves them more or less completely into binary inorganic compounds and the elements.

III. *Artificial Oxidation.*—Many highly oxygenated inorganic compounds, when in contact with organic bodies, part with one or more equivalents of oxygen, which in its nascent state acts on the organic compound; such is the case with a number of acids, viz., nitric (*see* Oxalic Acid, p. 430, and Sugars, p. 340), chromic (*see* Valerianic Acid, p. 379), chloric, and iodic acids, with peroxide of

manganese (*see* Formic Acid, p. 374), binoxide of lead (*see* Tartaric Acid, p. 431), and the oxides of the noble metals. Many organic compounds, when in solution together with alkalies, are thereby rendered more prone to oxidation by the atmosphere.

IV. "*Integration*" *with Elements or Inorganic Compounds.*—A number of non-metallic elements may enter the combination of organic bodies as integral parts; the halogens by direct influence, sulphur by the influence of sulphuric acid or a sulphuric compound (*see* Artificial Volatile Oils, etc.). The integration of HNO_2 has some importance in pharmacy; gun-cotton (p. 322) and glonoin (p. 388) are such compounds.

PART V.

PHARMACY PROPER (GALENICAL PHARMACY).

CHAPTER I.

ON THE DIFFERENT PARTS OF PLANTS, THEIR COLLECTION AND DESICCATION.

The plant is conveniently divided, for the purposes of the druggist, into the root, stem, bark, buds, leaves, flowers, fruit, and seed, and these different parts require the observance of different rules in regard to their collection, desiccation, and preservation for use in medicine.

Roots of annual plants should be dug immediately before the time of flowering; of biennials, or perennials, late in the fall, or very early in the spring. If the latter, it should be immediately after the first appearance of the plant above the ground. Perennial roots should not be gathered until after two or three years' growth. Rhubarb is allowed to mature for four or five years—asparagus till three years old.

Fleshy or succulent roots require to be cut previous to drying, so as to expose a large surface to the air; the mode in which they are sliced, whether longitudinally or transversely, is of interest in judging of certain foreign drugs, such as colomba root, which is always met with in transverse slices, gentian in longitudinal, the English variety of colchicum cormus, cut transversely, that from the Continent entire, etc. The mode of cutting is little regarded by herbalists in preparing the indigenous roots for market.

In all cases, it is important that the root, or other part of the plant, should be thoroughly dried. In the case of taraxacum, parsley, and other succulent roots, it is necessary to apply a heat of about 150° F., in order to destroy the eggs deposited by insects, which, through neglect of this precaution, may occasion the speedy deterioration of the root by worms. For drying roots, recourse may be had to a barrel open at both ends, and having a network suspended in it for holding the roots, it is to be stood over the register of a common house furnace.

The smaller and more fibrous roots, and especially those containing essential oils, require to be less thoroughly dried, and, as soon as their condition will admit of it, should be carefully put away into tight drawers, bottles, or tin cans. The stems of herbaceous

plants should be gathered after foliation, but before flowering, unless the flowers are to be used with the stem.

Barks of trees are best gathered in the spring, of shrubs in the autumn, at which seasons they can be most easily separated from the wood. They should be generally deprived of their epidermis, and dried spontaneously, their porous texture and comparative tenuity facilitating the process. Wild-cherry bark is often deficient in quality, from being gathered at the wrong season, and from the wrong part of the plant. It should be taken from the root in the eighth month—August. I have known it to become mouldy and lose its aroma by being put away too damp; when of fine quality, it has a strong and characteristic odor. The bark of wild-cherry is preferred to be taken from the root of the tree, and that of sassafras is always derived from the root, though in England the, much less valuable, wood is preferred.

Leaves should be gathered when fully developed, and before they have commenced to wither and fall; those of biennial plants, as the *solanaceæ* and digitalis, during the second season. After the appearance of the flowers, the leaves begin to lose their activity, the juices going to develop the fruit. In labiate plants the leaves are more aromatic as they approach the flowering tops, and the upper ones are frequently gathered with the tops. Leaves, slowly developed in a dry season, are believed to be most active.

Herbs, in which term are included whole plants and such parts of the same plant as are collected and sold together, should be gathered when in flower. Most plants which have thick and branching stalks or stems, should be deprived of these before being put up for sale, though experiment seems to indicate that a larger proportion of the active principle of belladonna is contained in the soft stems and midribs than in the cellular structure of the leaf.

Flowers may be gathered just before they are perfectly developed. The scent is less lively, and the color paler in fully expanded flowers, in consequence of the ovary growing at the expense of the accessory organs. The French or red rose is always gathered in bud, the astringent principle and beautiful red color being then best developed. A clear, dry morning, after the dew is dissipated, is to be preferred in either of these cases. They are dried in the shade, without artificial heat; the floor of a garret, through which is a draft of dry air, is well adapted to this purpose. *Fleshy fruits*, when designed for preservation, are generally plucked before they are quite ripe. It is found that raspberries, strawberries, blackberries, and mulberries yield a less glutinous and more agreeable juice when not "dead ripe;" the vegetable acids are then not so completely converted into sugar, and the aroma is fresher and stronger. The fruit of persimmon (*Diospyros*, U. S.), an indigenous astringent, is directed to be collected before ripening, owing to its

abounding in tannic acid, which, as it ripens, seems to be converted into sugar and apotheme.

Seeds, which are the least perishable of vegetable productions, should be perfectly ripe when collected; they require very little drying.

It should be remembered, when treating of the drying of drugs, that those dried by mere exposure to atmospheric currents are not by any means free from moisture; experiments upon this subject were made by G. W. Kennedy, of Pottsville, Pa., and published in vol. xliv. *Am. Journ. Pharm.*, page 158. They show a loss, when exposed to 120° F., varying from 16 to 9 per cent. for roots, 12 to 10 for stems and wood, 14 to 9 for barks, flowers, and herbs, 18 to 9 for leaves, and 9 to 8 for powdered roots. A part of this moisture is reabsorbed by subsequent exposure.

The "United Brethren," called Shakers, at their settlement in New Lebanon, New York, have extensive and convenient arrangements for drying these vegetable materials. Series of shelves of wire network are disposed in layers at suitable distances from each other, in large and well ventilated apartments; upon these the herbs are carefully placed, and allowed to remain subject to the desiccating action of the air, circulating below as well as above, until completely dried. They are then removed to capacious bins, of which many are arranged along the sides of the room, and preserved until nearly ready for pressing—an operation which, in common with some other herbalists, the Shakers practise upon every article of the Vegetable Materia Medica which they put up for sale.

This practice, while it has its advantages, is liable to some objections. It has been said that, owing to the moist condition to which the plants require to be brought before pressing, the packages are liable to become mouldy in the middle. I have never met with an instance of this kind, however, and believe that the excellent reputation the Shaker herbs have attained is well founded. Another objection to these herbs, of a very different character, is, that they are not adapted to the examination of the physical characteristics of the plants; a pharmaceutical student, placed in an establishment where they are sold to the exclusion of the dried plants in bulk, enjoys no opportunity of familiarizing himself with the physical and botanical characters of this extensive class of medicines; to this may be added the difficulty in noticing any deficiency in quality, any intentional or accidental adulteration, or error in labelling the articles.

Within a few years past herbs of very superior quality have been offered to the public packed and labelled very neatly by Messrs. B. O. & G. C. Wilson, of Boston. These herbs have their natural odor and color preserved in a remarkable degree, and seem worthy the confidence generally given them.

Very large quantities of several of the American medicinal plants enter into our commerce; spigelia and serpentaria are collected

chiefly in the southern and southwestern States; sassafras and wild-cherry barks, the root of asarum Canadense, and the leaves of hyoscyamus, belladonna, and conium (naturalized) in the New England States and in Canada, while taraxacum, eupatorium, lobelia, geranium, lappa, inula, dulcamara hydrastis, and many others, are gathered almost all over the country. The sources or the vast supplies of many of the leading American plants which enter into commerce are studiously concealed by the principal dealers, and the prices of the more important are subject to considerable fluctuations.

The business of collecting and drying medicinal plants is pursued in the vicinity of many of our large cities by herbalists, who realize a living from it. These have it in their power, by taking students of medicine and pharmacy with them on their excursions into the woods and fields, to extend a knowledge of medical plants among a class to whom it cannot fail to be in the highest degree useful and interesting.

There are few pursuits better calculated to relieve the monotony of a student's life, or to impart healthfulness and variety to the sedentary occupations of the apothecary, than a systematic out-door pursuit of the useful and ennobling science of botany; and the pharmacist or physician, by giving it a practical application to his business, may, in many instances, combine pecuniary with mental and physical advantage.

The *cultivation* of medicinal plants in the United States is mainly confined to the beautiful valley in Columbia County, N. Y., already referred to; this district seems especially adapted to the purpose, and, like the celebrated "Physic Gardens" of Mitcham and Hitchin Hurtz, in England, furnishes a great variety, and in large quantity.

Immense plantations of peppermint for the production of the oil exist in St. Joseph's County, in the southern part of Michigan, and in Ohio and Western New York. These are estimated to comprise an area exceeding 3000 acres, and to yield in oil of peppermint over $63,000 per annum.

For an interesting account of the "Physic Gardens of Mitcham," see *American Journal of Pharmacy*, vol. xxiii. p. 25; for some details in regard to the N. Lebanon Gardens, see the same journal, vol. xxiii. p. 386; and for an account, by F. Stearns, of the peppermint plantations of Michigan, see *Proceedings of Am. Pharm. Association*, 1858.

The question of how far the cultivation of plants diminishes or modifies their medicinal activity, is at present an undecided point; it is, however, universally admitted, that climate and soil exercise an important influence on their virtues, and the late edition of the *Austrian Pharmacopœia* particularly directs that in the case of aconite, the plant grown in gardens is to be rejected.

The opinion is adopted by many that most plants are more fully developed in the country in which they are indigenous, than in any to which they may be transplanted; but that there are many exceptions to this rule, if it be a general rule, must be quite apparent.

In the present state of our knowledge upon this subject, we cannot go further than to say that of plants indigenous to the temperate zones, some flourish equally on either continent, while others, owing to some want of congeniality in climate and soil, will only develop their peculiar properties fully in the localities to which they are indigenous.

At the gardens in New Lebanon, the narcotic herbs indigenous to Europe are cultivated with apparent success, and some of the extracts prepared from them are among the best manufactured.

The classification of the vegetable materia medica best adapted to the purposes of the druggist is that which groups the different parts of plants together, as indicated at the commencement of this chapter. This is the arrangement formerly adopted by me in the course of instruction in the Philadelphia College of Pharmacy, and nearly adhered to by my successor Prof. Maisch. Without any claim to a scientific basis, it is convenient, and affords especial advantages to the student who applies himself to the study of the physical peculiarities of the drugs.

In examining students with the special object of teaching them to distinguish different drugs, I am accustomed to take up those most resembling each other in succession, relying chiefly upon the exhibition of characteristic specimens, and the application of the ready tests supplied by the senses. If every physician, druggist, and pharmacist were to make full use of this method, there would be very few instances of mistaking aconite root for taraxacum, or briony for colombo.

Species are mixtures of vegetable substances, cut or bruised, and designed for use in the preparation of extemporaneous infusions; one of the most elegant of these, which has acquired considerable reputation as a substitute for many of the ordinary combinations containing senna, is the following:—

Species St. Germain.

Take of Senna, previously digested in alcohol and dried	4 ounces.
Elder flowers	2½ ounces.
Fennel seeds,	
Aniseed, of each	10 drachms.
Cream of tartar	6 drachms.

Mix, and divide into papers containing five drachms.

Directions.—Infuse the contents of one package in half a pint of boiling water, strain, and take at a dose.

The treatment of senna with strong alcohol deprives it of odorous principles without materially impairing its cathartic properties.

Gerhard's Tonic Tea.

Take of Gentian, half a troyounce.
Rhubarb, one drachm.
Ginger, two drachms.

Bruise them thoroughly, mix them, and add—

Bicarbonate of soda, one drachm.

Directions.—Infuse in a pint of boiling water, and give a wineglassful three times a day.

Anthelmintic Species.—Worm Tea.

Take of Spigelia, half a troyounce.
Manna, half a troyounce.
Senna, two drachms.
Fennel, one drachm.

Contuse the spigelia, and mix it with the other ingredients.

Directions.—Infuse in a pint of boiling water, and give a child two years old or upward, half a teacupful, warm, morning, noon, and night, before eating.

CHAPTER II.

ON THE POWDERING OF DRUGS AND ON POWDERS.

According to the plan of this work, the first class of preparations treated of is that of powders.

The preparation of the material for powdering consists of garbling or sorting, and drying it. The former process pertains to the druggist, and the latter mainly to the drug grinder.

The object of *garbling* is to separate any impurities or adulterations, and any decayed or deteriorated portions of the drug. In nearly all drugs, especially those of vegetable origin, there are great variations in quality, and even in the same lot there are frequently very good and quite worthless specimens. As an illustration of this, Chinese rhubarb may be instanced: the roots, when broken, are found to vary exceedingly in quality, even in the same case; some are heavy and compact in structure, breaking with a very uneven fracture, presenting a red and yellow marbled appearance, giving a gritty impression between the teeth, and the peculiar bitter, astringent taste characteristic of the drug, while other roots are comparatively light, spongy in structure, and almost destitute of the peculiar color and taste; others, which have the requisite specific gravity and the external appearance of a good article, are dark-colored within and quite inferior; others are so worm-eaten as to be quite worthless. The custom of some druggists, when about to send a lot of rhubarb to the mill, is, either to send it in the mixed condition in which it is imported, or to select from it the finest pieces for separate sale, and for a sample, and send all the inferior roots, with perhaps only a small portion of the best, to be powdered.

A druggist who exhibits the best roots, selected in this way, as a sample of the kind powdered, cannot be acquitted of a gross and unpardonable fraud upon his customers. If he sends the whole case, containing good, bad, and indifferent, as originally imported,

he may at least claim that, though he has not improved the quality of the medicine in reducing it to powder, he has not rendered it worse. But, with a view to furnishing a good and reliable medicinal agent, without regard to price, he should garble his rhubarb, by cracking each root, rejecting the decayed and otherwise defective pieces, and preserving in the form of powder only that which is of value. This is done by some, who are more desirous of a reputation for the quality than for the cheapness of their drugs.

Notwithstanding the difficulty of distinguishing the quality of medicines in powder by their sensible properties, we have in the case of rhubarb, general indications of excellence in a bright yellow color, a heavy and compact character in which the particles are not dustlike and mobile on the surface, and a well-marked and unmixed rhubarb odor. By a careful study of the characteristics of powders, their colors, compactness, or mobility, and, above all, their resemblance in odor and taste to good specimens of the drug, the physician and pharmacist may reach considerable skill in judging of their quality, and even in detecting adulterations.

In a subsequent chapter I shall have occasion to refer to the variable quality of powdered gum Arabic; this is mainly owing to the neglect of garbling, or to the use of the rejected portion, after garbling, for reduction to powder. It is desirable to have the whole gum free from dusty and gritty particles; in this condition, it is more elegant and convenient for chewing, and for making the nutritive mucilaginous drinks so much used by invalids, and it commands a better price. It is, therefore, customary to sift gum, as taken from the case, and the inferior kinds of powder are made from these siftings, which contain the dust, particles of sand, and other impurities.

A good powdered drug must invariably command an advance on the price of the drug in its crude state, the loss by drying, waste, cost of powdering (from 6 to 12 cents per pound), and other incidental expenses, to say nothing of the loss by garbling, furnishes a sufficient answer to those who complain of the high price of choice powders.

The chief reason for the deficiency in the quality of medicinal powders is found in the reluctance manifested by the public, and retail apothecaries and physicians, to pay a liberal price for them. Powders are not unfrequently sold at a less price than the whole drug, especially when the article is costly, and of variable quality in commerce. This is true, especially of rhubarb, jalap, gum Arabic, and the spices, which, as a general thing, cannot be recommended in powder with the same confidence as in the unpowdered condition, or in the form of Galenical preparations, prepared from the whole or contused drug.

Drying and Powdering.—When a drug is sent to be ground in its ordinary condition, it generally requires drying previously to being submitted to the action of the mill.

Moist and tenacious substances, such as the gum resins, opium, aloes, squill, jalap, and colocynth, and all fresh roots and herbs,

require this treatment to a certain extent, and the drug-mills are supplied with apartments, or steam-baths, adapted to it. These are heated to a temperature of about 120° F., and the drug is allowed to remain in them as long as is deemed necessary to deprive it entirely of water.

Some drugs are injured by this process; the volatile ingredient, so often the active principle, suffers great loss, and the resulting powder is comparatively inefficient. Myrrh and assafœtida furnish good illustrations of this.

On the other hand, substances possessed of no active volatile ingredient, but containing a large amount of water, as opium, are enhanced in value by drying and powdering. Some specimens of opium diminish in drying and powdering to the extent of 20 per cent., which, if the process is properly conducted, increases the efficiency and value of the drug in that proportion. Experiments under my own supervision show about an average loss of 9 per cent., in reducing tolerably hard opium to the pulverulent condition. It is on this account, and from the fact that the powder, when unadulterated, is more nearly uniform in its composition than the drug in mass, that the *U. S. Pharmacopœia* directs the use of powdered opium in making all the Galenical preparations of that drug.

Elecampane root is said to lose seven-eighths of its weight in drying; stramonium leaves, nine-tenths; hyoscyamus and belladonna leaves, nearly as much. If these plants lose nothing but moisture in the process, and retain all their active medicinal properties unimpaired, it is obvious that they are seven or eight times stronger when in powder, or in a dry condition, than when recent. It is, moreover, a generally received opinion that vegetables yield their virtues by infusion more readily when dried than when they are fresh.

Oily drugs, such as flaxseed and mustard seed, offer the greatest obstacles to the usual methods of grinding, and millers who are skilful adapt their processes to prevent the direct pressure of the grinding surface, and the consequent rise of temperature, calculated to "raise" the oil; they adopt a cutting rather than a triturating action, using a pair of horizontal mill-stones, sharp and "dressed," for the special purpose, and not allowed to come in contact in the course of their revolutions. In this way flaxseed meal may be produced which contains the oil without appearing greasy, and from which the hull and chaff have been sifted.

If the attempt is made to reduce these oily seeds in a mortar, the object will be retarded, if not frustrated, by the pressing-out of the oil before the requisite disintegration of the structure.

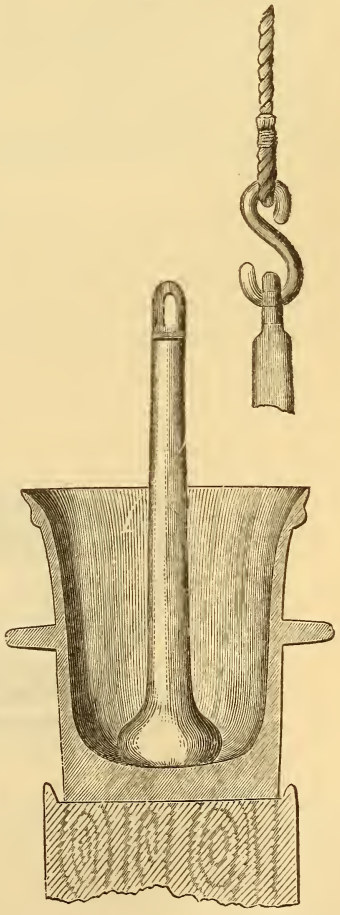
A difficulty, liable to occur in powdering drugs at the mills, is due to the accidental admixture of foreign substances with them. The extensive grinding surface employed becomes so completely covered with the fine powder, that it is cleaned with great difficulty; so that the next substance introduced becomes contaminated with it, sometimes to its great disadvantage. This is observed in certain articles of delicate flavor, as orris root and vanilla.

The plan of *dusting* powders, which insures their extreme fineness, and the separation of any earthy impurity, has gained in favor of late years. The apparatus now used is constructed so that the powdered drug, when it has passed between the grinding surfaces, is thrown by a draught, created by the revolving stones, to a height of about five feet, and is then allowed to settle upon the adjacent parts, from which, after it has collected in sufficient quantity, it is removed.

It will be appropriate, in this place, to give some observations upon powdering, as practised, on a small scale, in the shop and laboratory. This is accomplished by means of mortars, suited to the different processes of contusion and trituration, and by mills.

Mortars for contusion are usually made of iron, brass, or bell-metal, of the shape shown in Fig. 179. Contusion is employed for powdering and bruising ligneous substances generally, being adapted to breaking apart their fibres, and, by the violent attrition of the coarser particles with each other, reducing the whole to a more or less fine powder.

Fig. 179.



Mortar and pestle for contusion.

Care must be taken to avoid treating any corrosive substance in the iron mortar, thus allowing it to become rusty; or, if this should occur, it should be carefully washed out with diluted muriatic acid, and scoured with clean sand, to fit it for use. Any adhering material should be cleaned away immediately after the mortar is out of use, as it is then more easily removed than if allowed to remain and harden. The mortar is thus always ready for use.

In powdering substances by contusion too large a quantity should not be introduced into the mortar at one time; if the mortar is small, sufficient to cover the bottom for the depth of an inch or two; the flattened extremity of the pestle is then to be brought into direct and violent contact with it, each successive stroke being aimed at the same spot in the centre of the circle formed by the sides and bottom of the mortar. Many substances are too stimulating or otherwise injurious to

allow of their being advantageously powdered in a mortar, and the practice of employing apprentices in this way is more honored in the breach than in the performance. In cases of necessity a cover of leather secured around the rim of the mortar and tied to the pestle at such a point as to allow of its free movement in the process of contusion is a wise precaution. When part of the contents under treatment assumes the condition of a fine powder, which is exhibited by the air becoming charged with the dust, it is well to sift it, and thus separate the fine from the coarser particles, these last being returned to the mortar, and further contused until a second sifting becomes necessary, and so on till it is finished. A small portion of the drug is usually left in powdering, which it seems impossible to reduce sufficiently; this is part of the ligneous portion, which is frequently inert; the drug-grinder who obtains a considerable quantity of this *gruff*, as it is called, usually retains it for admixture with the next lot of the same drug he is called upon to grind, in this way reducing somewhat the loss upon it: he is usually allowed a small percentage for this necessary deficiency in the powdered product.

The mortar and pestle adapted for trituration are shown in Fig. 180. Such a mortar requires to be more carefully handled than one

Fig. 180.

Wedgewood mortar and pestle.

for contusion. It is adapted to the reduction of saline substances and chemicals generally to powder, by the friction of their particles with each other, between the hard and rough surfaces of the mortar and pestle. The ware, being brittle, should not be subjected to blows with the pestle; it should be carefully wiped out and laid away, after using, so as to be dry and clean whenever needed.

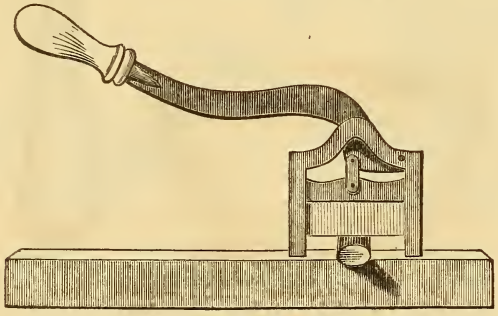
The mode of manipulating with the wedgewood mortar and

pestle, after placing in it the material to be ground to powder, is to grasp the pestle firmly with the right hand, holding the mortar with the left if necessary, and gradually to traverse the mortar with the pestle from the centre outwards, reaching the circumference gradually, by a spiral motion; and then, by reversing the direction of this motion, to bring the pestle again to the centre; in this way all parts are brought fully and equally under the action of the pestle. When the contents of the mortar become caked, and cease to fall towards the centre, when agitated, which often happens as the powder becomes very fine, a spatula should be occasionally run around the sides and bottom, to loosen and mix together the different portions.

A loose and careless way of triturating substances is productive of no saving of labor; the conditions most favorable to pulverization by trituration are a constant, uniform, and hard grinding motion communicated to the pestle, the layer of powder intervening between it and the mortar being thin, and the mortar so shaped as to present all parts of it equally to the action of the pestle.

Many substances can neither be reduced to powder by the process of contusion nor by that of trituration; of these, nutmeg may be instanced as one which is most conveniently grated, or scraped off with the blade of a knife; vanilla is another instance, this may be cut into short transverse pieces with shears and afterwards triturated with a third substance; if reduced with a view to infusion or displacement with alcohol, sand may be conveniently employed; if water is to be used, or if it is to be dispensed in a dry condition, hard lumps of sugar may be advantageously substituted. Many oily substances, such as nutmeg and cardamoms and other aromatic

Fig. 181.



Tobacco knife.

seeds, can be made into convenient powders with dry and ligneous substances, although themselves unsuited to this form of preparation. Orange-peel, slippery elm, mezereon bark, liquorice root, are best comminuted by cutting them with a pair of shears, or a knife fastened on a lever, such as tobacconists use for cutting tobacco into plugs, and then drying them and introducing them into a suit-

able mill. The mode of cutting a piece of liquorice root into convenient pieces for chewing, is shown in the drawing.

Quassia, guaiacum, logwood, and red saunders are chipped by machinery, the two latter for use in the arts.

Camphor is easily reduced to powder by adding to it a small portion of some liquid in which it is soluble, as, for instance, alcohol, and triturating to dryness; the proportion of alcohol proper to be added to camphor for this purpose is about one minim to three grains. As camphor thus prepared will not retain its impalpable condition alone, it is desirable to incorporate with it immediately any dry powder with which it is designed to be mixed, as, for instance, precipitated carbonate of lime, where it is to be used as a dentifrice.

The following process, by my friend H. F. Fish, of Waterbury, Ct., is adapted to furnish a permanent powder of camphor: To 16 ounces of camphor add two pints of alcohol (sp. gr. .818). In a porcelain mortar triturate one drachm of magnesia with as much water as will enable the mixture to blend freely with 8 pints of water, with which it is then to be thoroughly mixed in a suitable wide-mouthed bottle. The alcoholic solution of camphor is now to be poured into this in a thin, slow stream, constantly stirring the fast-thickening mixture. A dense, white, curdy "separate" ensues, which gradually condenses, and rises to the top of the liquid. When collected on a filter, and cut with a spatula, this parts readily with its moisture, and should not be pressed or too thoroughly dried before being transferred to bottles excluded from the light. The proportion of magnesia is only one grain in 128, and constitutes no objection to its use for most purposes.

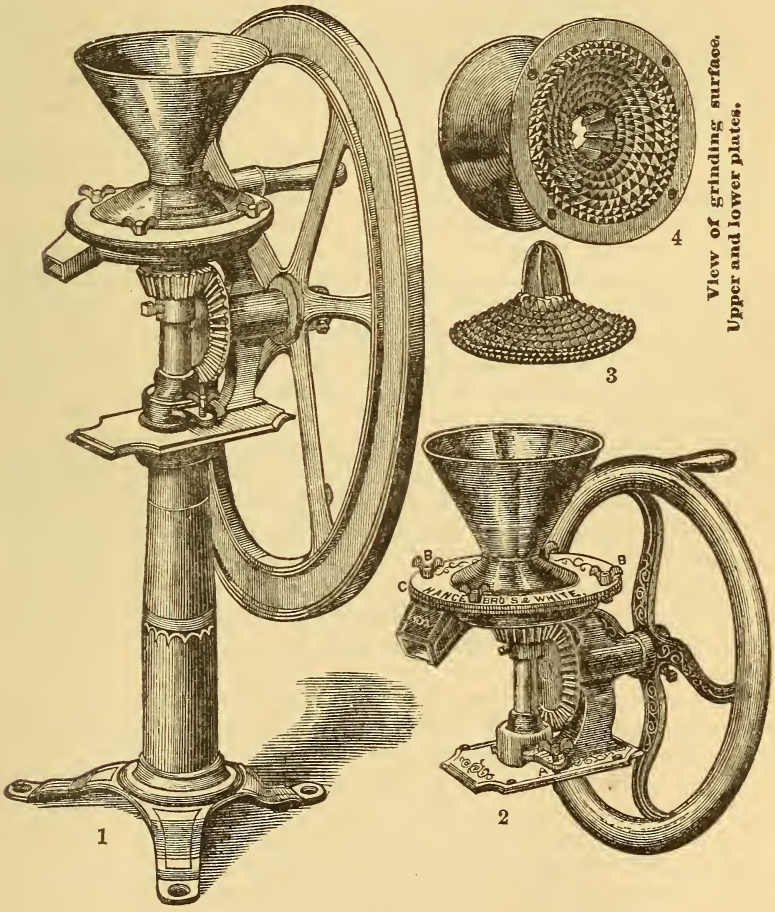
This method is objected to, as it leaves the powder in a moist condition undesirable for an errhine or tooth powder. A process which is free from this objection is that of Mr. J. C. Loud, in which the camphor is placed in a small copper retort four inches in diameter and ten inches in height, with a curved neck two inches in diameter and fourteen inches long. The chamber into which the camphor is sublimed is a cube of 3 feet, made by pasting properly sized paper over a light frame. After the retort neck is well luted to the chamber, heat is applied to the retort, by lamp or preferably by sand-bath. Thirty minutes suffice to sublime one pound; if packed in full bottles, well excluded from air and heat, it will retain its pulverulent condition a long time.

Some gum resins, such as assafœtida, are too tough to be reduced to powder unless previously heated, which, as before stated, drives off a portion of their active principles, while those which appear pulverizable cake together at the temperature produced by the friction of the grinding surfaces. These should be powdered in very cold weather, when they will suffer no loss of their volatile principles, and if carefully sifted, will retain the pulverulent condition. During the warm season the powder is liable to cake somewhat, but yields to the pressure of the pestle.

The powders of these gum-resins, as met with in commerce, are

often nearly worthless, but prepared as above, even powdered assafœtida answers an excellent purpose, and with the exception of its increased tendency to deteriorate from the greater extent of surface exposed to the action of the atmosphere, might claim a place among the approved preparations. All these powders should be kept in well-stopped glass bottles.

Fig. 182.



Hance's drug mill.

Fig. 182 represents a convenient mill for the use of druggists and pharmacists, manufactured by Hance Brother & White, of Philadelphia.

It is an improvement on Swift's drug mill, figured in the previous editions of this work. The advantages are that the grinding surfaces are horizontal and thus retain the substance for a longer time under the action of the plates, the speed being multiplied by a bevelled gear wheel working into one of smaller diameter, and the superior strength of those parts liable to the greatest strain.

For further remarks relative to this mill, the reader is referred to a paper by Thomas J. Covell in the 20th vol. *Am. Pharm. Association Proceedings*, page 180.

Numerous spice and coffee mills, sold by dealers in household and agricultural implements, will be found to serve useful purposes in the pharmaceutical store, and will often prevent a resort to contusion in the iron mortar, a noisy and laborious method of comminuting drugs, now much less used than formerly. Before introducing tough and pliable substances, such as squill and gentian, into the mill, they should be well dried; the larger roots and barks require to be first broken with a hatchet, or suitable knife, before grinding, and some will need to be first passed through the mill set for the coarse powder, and then, the mill being regulated, they can be reduced to the required condition by repeatedly passing them through it. The season of the year for powdering is not a matter of indifference, and it is believed that few drugs would prove intractable in the frosty weather of winter. So constant is the demand for powders of the various degrees of fineness adapted to treating the several preparations, that it would prove a useful precaution for the pharmacist to appropriate a few days, during the winter, to preparing them for the year, each being passed through the appropriate sieve, and put away in a tin box, properly labelled, till required for use.

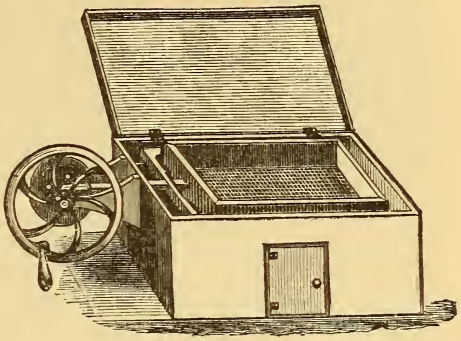
Sifting.—The fineness of powders is usually regulated by the use of sieves which will separate particles of different degrees of division; the finest bolting cloth will only pass those which are almost impalpable, while coarser sieves are adapted to the preparation of powders suited to percolation. In all cases when the powder is to be used in divided portions, care should be taken to mix the different siftings thoroughly together, as the more ligneous and least active portions usually resist the operation of the pestle longest and are in the last siftings.

The usual kind of sieve is made in the form of a drum, and is designated according to the number of wires or meshes to the linear inch; Nos. 20 and 40, which are adapted to coarse powders to be used for percolation in the preparation of certain tinctures and fluid extracts, have 20 and 40 meshes respectively to the linear inch, while No. 60 or 80 gauze, or bolting cloth, which separates all but the very finest particles, are used in preparing powders adapted to internal use. In the *United States Pharmacopœia*, the terms very fine, fine, moderately fine, moderately coarse, and coarse are used; the powder passed through a sieve of eighty or more meshes to the linear inch being designated as *very fine;* through one of sixty meshes, *fine;* through one of fifty meshes, *moderately fine;* through one of forty meshes, *moderately coarse;* and through one of twenty meshes, *coarse.*

An inclosed cylinder or many-sided figure is the best form for a sieve; by rotating it on its axis its contents are thrown constantly upon a fresh portion of the gauze, and thus subjected to the most favorable conditions for the separation of their fine particles.

Fig. 183 represents a sifting machine, patented by Samuel Harris, of Springfield, Mass., which is well adapted to facilitate the process. It consists of a wooden box, with a flange, upon which an oblong sieve is made to move by a wheel and crank, the construction of which is shown in the drawing; by closing the lid the dust is prevented from rising in the air, and one of the most common causes of waste and annoyance is thus obviated. The powder as it falls from the sieve is received into a close-fitting drawer beneath. The sieve is movable, so as to be emptied without inconvenience, and by having sieves of different degrees of fineness, it will be obvious that the apparatus may be adapted to all the purposes of the pharmacist. The sizes of this apparatus are so varied as to suit numerous purposes, not only in pharmacy, but in the arts and in agriculture.

Fig. 183.



Harris's sifting machine.

The operation of *sifting* may also be varied according to the degree of fineness required in the powder. To pass the finest particles only the sieve should be gently agitated, the powder being laid lightly upon it, and the operation being suspended as soon as it has ceased to pass through readily; the plan of rubbing the powder over the sieve with the hand, thus using more or less pressure to force it through the meshes, may be pursued when the fineness of the powder is not so much desired as the rapidity of the process; but this practice ought not to be pursued with bolting-cloth sieves, as it tends to injure them very much.

The difficulty constantly met with by pharmacists, of fine powders becoming caked into soft masses, is conveniently remedied by the use of the little instrument called Blood's patent flour sifter, which is constructed with a curved wire-gauze bottom, over which a rounded wooden bar moves by means of a lever, which also serves as a handle to the apparatus. It is constructed for household purposes, but could hardly be better adapted for resifting fine powders, or for mixing powders, as frequently required by pharmacists; it is procurable, at small expense, at the stores for the sale of household articles.

Powders.

Powders, as a class of remedies, possess the advantage, when skilfully prepared, of uniting all the proximate principles of the plant, in their natural condition, and may be administered without the intervention of any menstruum. They may be used in bulk,

taken into the mouth with water or some viscid liquid; or may be made into pills; or suspended in liquids in the form of mixtures. (*See* Part VI., Extemporaneous Pharmacy.)

The disadvantages attendant upon their use are these: they are frequently too bulky for convenience, the dose being so large as to be repulsive to the patient, vegetable powders generally containing a considerable proportion of inert ligneous matter; many of them are liable to undergo an unfavorable change by exposure to the influence of the atmosphere, especially when it is charged with moisture, and they are liable to be injured by light. Vegetable powders are also subject to adulteration, the detection of which is difficult.

Except in the few cases, such as opium and cinchona bark, where we may isolate the active principle, and ascertain the proportion contained in a given sample, it is difficult to judge with certainty of the quality of a powdered drug; the best safeguard of the physician against fraud or the effects of carelessness, where the vegetable powders are concerned, is to buy them of careful and conscientious druggists, who either powder them or exercise a strict supervision over the process as conducted by the drug-grinder.

The fineness of powders affects their color, as is manifest in the case of white saline substances, which become whiter by long trituration.

There is no separate class of *simple* powders in the *Pharmacopœia;* they are understood to be included in the Materia Medica list. The *compound* powders which are officinal are included in this work under the general head of extemporaneous powders and pills, and designated by *U. S. P.* A table of them will, however, be useful to the student in this connection.

Pulveres, U. S. P.

Name.	Proportions.	Med. Prop.	Dose.
Pulvis Aromaticus	Cinnamon 2 p. Ginger 2 p. Cardamoms 1 p. Nutmeg 1 p.	Carminative.	
" Aloes et Canellæ (Hiera Picra)	Aloes 4 p. Canella 1 p.	Stomachic Laxative	20 grains.
" Ipecacuanhæ comp. (Dover's Powder)	P. Ipecac 1 p. P. Opium 1 p. Sulph. Potass 8 p.	Sedative Diaphoretic	10 grains.
" Jalapæ compositus	P. Jalap 1 p. Bitart. Potass 2 p.	Cathartic	20 grains.
" Rhei compositus	P. Rhei 2 p. Magnesia 6 p. Ginger 1 p.	Cathartic Antacid	1 drachm.
Pulveres Effervescentes	Sodii bicarb., pulv. gr. 30 Acidi tartarici gr. 25	Refrigerant	as directed in formula.
" " Aperientes	Sodii et Potass. Tart. gr. 120 Sodii bicarbonatis gr. 40 Acidi tartarici gr. 35	Aperient and Refrigerant	as directed in formula.

The necessary practical hints in regard to the mode of preparing and dispensing these, are given under the appropriate head in the chapter on Dispensing.

"Lactinated" Powders.

In order to render soft or semifluid preparations, especially oleo-resins, suitable for use in the form of powder, they are variously combined with dry and bulky substances, such as magnesia, sugar, and, preferably, lactin (sugar of milk). The hardness of lactin, and its comparative insolubility and inertness, adapt it to the very thorough division and dilution of substances triturated with it. Some pharmacists of the "Eclectic" school have adopted the form of powders for their so-called "concentrated remedies," which are prepared by an alcoholic menstruum from the drug, evaporated to an oleo-resinous consistence, and then incorporated with a dry and bulky powder, perhaps, in most instances, lactin. The advantages claimed for this method are that, while it converts inconvenient fluid or semifluid preparations into the eligible form of powders, it has little or no effect upon their composition or properties, except to increase their activity, by dividing and diffusing them in the stomach, at the same time diminishing their direct local effect upon that organ. These lactinated powders are, moreover, freely miscible with water, and much more easily dispensed than the isolated remedies from which prepared. They should be kept in dry and well-secured vials, and this form of preparation should be limited to articles not deliquescent in their nature, and such as are soluble in an alcoholic or ethereal menstruum, so that they may be readily incorporated with the lactin, without dissolving it, and that the menstruum may rapidly evaporate without too much heat.

These lactinated preparations are made by incorporating with the concentrated remedy, one, two, five, or ten parts of the dry powder, and the degree of this dilution should be invariably stated in the label, together with the dose. With this precaution, they may serve a useful purpose in practice.

CHAPTER III.

ON SOLUTION AND FILTRATION.

THERE are two objects in view in this process, and the principal feature in the classification of solutions is founded on this fact.

The simplest kind is that in which, by the use of an appropriate liquid, we overcome the attraction of aggregation in a solid body, rendering its particles invisible and more susceptible to chemical action, and more readily assimilated when taken into the stomach. The liquid used for this purpose is called a solvent, and water, the

great neutral solvent, is most used in preparing them, though alcohol, ether, chloroform, and fixed oils are also more or less employed as pharmaceutical solvents.

Such solutions are designated *simple solutions* when the dissolved body may be recovered without having undergone any chemical change, on the evaporation of the solvent, or its removal in some other way. When the solution of a body is attended with some chemical alteration, either composition or decomposition, the term *complex* or *chemical* solution may be applied to it.

It is but rarely the case that the simple solvents above named produce decomposition in dissolving a body; the solvents for effecting chemical solution are mostly acid or alkaline liquids.

A large number of the solutions used in medicine are effected by inducing chemical changes among the ingredients introduced into them, sometimes yielding soluble compounds where one or more of the original ingredients were insoluble. Such processes are frequently accompanied by the generation of heat, and the change of color and odor, the latter by the neutralization of volatile acids or bases. Effervescence is always produced when, by the action of an acid or an acid salt, carbonic or another of the few gaseous and sparingly soluble acids is set free; in this case there is usually no change of temperature observed, as the heat produced by the chemical reaction is rendered latent by the gas. In the preparation of solution of citrate of magnesium from citric acid and calcined magnesia, the mixture becomes hot, while, if the carbonate of magnesium is used, the solution remains cold, and the same phenomena are observed on the neutralization of other acids by bases and their corresponding carbonates.

When we speak in general terms of the solubility of any solid substance, we have reference to its relation to water, the term being an approximate one. Very few substances exist in nature wholly insoluble; and as there is no line between the least soluble, and those which are freely dissolved under ordinary circumstances, the term is not adapted to use where accuracy or precision of language is required.

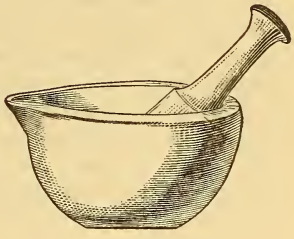
Solution is accomplished by bringing the material under treatment into contact with the solvent under favorable circumstances; these relate, 1st, to temperature; 2d, to the state of aggregation of the solid; 3d, to its position in relation to the solvent.

Hot liquids dissolve substances with greater facility than do cold; with exceptions, among which are lime, its citrate and acetate, and chloride of sodium. Though heat favors solution, there are no substances wholly insoluble in the cold, which dissolve by the aid of increased temperature. In addition to the greater solvent power of hot liquids, the currents produced by the process of heating them favor the more rapid solution of the contained solids, as shaking up the vessel favors the same result.

To facilitate solution in a small way, mortars are much employed; they serve the double purpose of reducing the solid to powder, and of facilitating its intimate mixture throughout the

liquid. Mortars of porcelain ware (Fig. 184) are most suitable for this purpose; they are used as follows: The substance to be dissolved is first placed in the mortar and rubbed into a powder, by which the extent of surface to be brought in contact with the liquid is greatly increased. The process of solution proceeds more slowly as the liquid becomes more nearly saturated, hence a small portion of the solvent is first added and triturated with the powder; as soon as this portion seems to be nearly saturated, it is poured into another vessel, and an additional portion of the solvent added, triturated, and poured off in the same way; a fresh portion again being added, the process is repeated, and so continued till the powder has disappeared. The liquids thus obtained, being mixed, furnish a stronger solution than could be prepared in the same length of time under the ordinary circumstances of contact.

Fig. 184.



Porcelain mortar.

When a weak solution is to be made, especially of a delicate chemical substance, like nitrate of silver, a good way is to drop the crystals or powder into the liquid previously placed in a clean vial of suitable size, to which a cork has been fitted, and to shake it up until dissolved. This should only be done in the case of very soluble substances, and the shaking should be continued as long as any portion remains undissolved.

A good arrangement for effecting solution by what is called circulatory displacement, is to place the solid on a perforated diaphragm resting beneath the surface of the liquid, or to inclose it in a bag of some porous material, and suspend it by a thread in the vessel near its top. By this contrivance, that portion of the liquid having the greatest solvent power, because the least saturated, is always in contact with the solid; the solution, as it becomes saturated, becomes denser and sinks to the bottom, displacing the portion less charged with the solid ingredient, which, in consequence of its less specific gravity, tends to the top, thus keeping up a continual circulation in the fluid favorable to the object in view. In large operations in the arts where it is impossible to shake or to stir the liquid conveniently, an arrangement based upon this principle is adopted, and in smaller pharmaceutical operations Squire's infusion mug, figured in a subsequent chapter, will be found to answer a good purpose.

The term *saturated*, besides its physical and pharmaceutical application as above, is employed to signify that an acid is neutralized by an alkali, or *vice versa;* or, in other words, that an equivalent proportion of one substance has combined with an equivalent proportion of another, for which it has an affinity; they are then said to have saturated each other. The term, when used for this purpose, may be said to be a strictly chemical one, but when employed

as above, to designate the point at which a liquid ceases to dissolve a solid body, it is used in a pharmaceutical sense. It is worthy of remark that the saturated solution of one salt is frequently a solvent for other salts, a quality of great value in the preparation and purification of salts in the arts.

Rapid solution, even when not accompanied by chemical reaction, generally causes a reduction of temperature, and thus retards the process to a certain extent; this is due to the increase of capacity of bodies for caloric, while passing from the solid into the liquid state; or, in other words, to the absorption of heat. This heat becomes insensible, and is called *latent* heat, but it is set free again on the body resuming the solid form.

In arrangements for solutions on a large scale, it becomes important to counteract this effect by contrivances for keeping up the temperature of the liquid; this is conveniently accomplished by jets of steam or coils of steam pipe.

Solutions are not confined to solids in liquids. One liquid may dissolve in another, as, for instance, ether in water, and essential oils in alcohol. When no chemical combination takes place, volume and temperature remain unaltered, while chemical combination of the two liquids is generally accompanied by a rise of temperature, and a condensation of their volume; the mixing of water with strong alcohol and concentrated acids furnish such examples.

Gases are also capable of being dissolved by liquids, and if they are soluble therein to any extent, the process is accompanied by a rise of temperature, because the latent heat of the gas becomes sensible again, on assuming a denser state of aggregation, hence the application of cold or freezing mixtures favors the solubility of the gases, by counteracting this sensible heat. An increase of pressure, by condensing the volume of a gas, is also favorable to its solution in liquids.

Chloride of ammonium, and carbonate and nitrate of potassium, and other saline substances are conveniently reduced by the process of *granulation*, which consists in dissolving the salt in water and evaporating to dryness, constantly stirring. The process is only applicable to a few articles which are freely soluble and not readily decomposed or volatilized by heat. The granulated powders thus produced are generally quite different from powders made by mechanical means; they may be gritty from being composed of small crystals, or, in the case of deliquescent salts, they may have a globular form from the heat being continued till most if not all the water of crystallization has been expelled.

Many of the insoluble powders are obtained by precipitation; as, for example, precipitated sulphur, prepared by dropping muriatic acid into a solution of bisulphide of calcium and hyposulphite of calcium; the calcium and chlorine present, uniting with the acid, form chloride of calcium and water, the former being extremely soluble. The sulphur, which is insoluble, is thus precipitated as a fine powder.

On the same principle, the precipitated carbonate of calcium is

prepared by adding a solution of carbonate of sodium to a solution of chloride of calcium. As a result of the reaction the insoluble carbonate of calcium is produced, and is thrown down in the form of a powder.

It is worthy of remark, in regard to these powders generally, that they are composed of very small crystals. Their fineness is dependent upon the temperature and degree of concentration of the liquids when mixed. When the solutions are hot and concentrated, the reaction takes place suddenly, and the powder is very fine; when they are cold and more dilute, the precipitate is deposited gradually, and more perfectly assumes the crystalline form; or if the precipitate is not entirely insoluble, it is deposited in crystals from the hot solution on cooling.

Tartar emetic is obtained in a very fine powder, suitable for preparing the ointment, by dissolving it in water, so as to form a strong solution, and then pouring it into alcohol. The strong affinity of water for alcohol causes them to unite, and the tartar emetic, being less soluble in the alcoholic liquid, is thrown down in an impalpable powder.

In a similar manner a pure powder of protosulphate of iron may be obtained, if its filtered solution, acidulated with sulphuric acid, is added to strong alcohol; the sulphate of the peroxide of iron remains in solution, while the protosulphate is precipitated in the form of a crystalline, light-greenish powder, which should be rapidly dried in a current of air, and is then less prone to oxidation than the ordinary crystallized salt.

Another process for obtaining some powders is that known as elutriation. Although the vehicle used is not a solvent, and therefore it is not to be properly treated of under this head, still, as the process closely affiliates the manipulation of obtaining powders by solution, it will be most conveniently here described. The article to be powdered is ground in a mortar with a large quantity of liquid, and this is poured off into a precipitating jar; after the subsidence of the finest particles, the clear liquid is again returned to the coarser portion, which is ground anew with the liquid. The decantation and collection of the powder are continued till the process is completed.

As stated in the beginning of this chapter, the principal effect of solution is shown in overcoming the cohesion of solids, and this is resorted to in obtaining granulated powders from various saline substances.

Classification of Solutions.

Until the revision of the national standard in 1860, the aqueous and a few of the alcoholic solutions (tinctures) were introduced throughout the work under the heads of the several chemical substances which they contain, an arrangement adhered to in this treatise as most consistent with its plan.

The strict alphabetical arrangement of the *Pharmacopœia*, and

the intentional avoidance of a scientific classification, have induced a change in that work by which all aqueous officinal solutions are given under one head, named *Liquores.* These are classified under several subordinate heads in the syllabus which follows.

The *waters*, including solutions of essential oils and of gases in water, constitute a separate class in the *Pharmacopœia;* those containing solid and liquid essential oils are treated of under that head in this work, but, for obvious reasons, the others are introduced under their several chemical bases.

Of the alcoholic, oily, and ethereal solutions, the *Pharmacopœia* makes the several classes tinctures, wines, spirits, and liniments, and others, as Fluid Extracts, concentrated by evaporation, with which convenient arrangement this treatise mainly coincides; there is, however, no more familiar and convenient distinction between preparations, whether in solid or liquid form, than that which divides those derived from plants and parts of plants, from substances of mineral origin ; this distinction, which is not so completely maintained in the *Pharmacopœia*, owing to its arrangement as above described, is carried out in the plan of this work.

For full directions for the preparation and properties of the solutions in water, see the several chemical heads under which they occur in Part III., and the extemporaneous prescriptions in Part VI.

General View of the Officinal Solutions.

Class 1st.—*In Water.* (*Liquores and Aquæ.*) U. S. P.

1st Group.—Made by simple solution.

a, *of Fixed Bases.*

	Contents, etc.	Dose.	Properties, etc.
Liquor Potassii (2d Process)	℥j KHO to Oj	♏ x	Antacid, Antilithic.
" Calcis	Ca2HO + aq., saturated	f℥j	Antacid, Astringent.

b, *of Salts.*

	Contents, etc.	Dose.	Properties, etc.
Liquor Barii Chloridi . .	℥j BaCl + f℥iij aq	♏ v	Alterative.
" Morphiæ Sulphatis	gr. j to f℥j aq	f℥ij	Narcotic.
" Potassii Permangan.	$K_2Mn_2O_8$ gr. 64 to aq Oj	f℥j	Disinfectant.
" Sodii Arseniatis .	$Na_4As_2O_7$ gr. iv to f℥j	♏iij to x	Alterative.

2d Group.—Made by chemical processes.

a, *of Fixed Bases.*

	Contents, etc.	Dose.	Properties, etc.
Liquor Potassæ	5.8 per cent. KHO	♏ x	Antacid, Antilithic.
" Sodæ	5.7 " NaHO	♏ x	do

b. *of Salts.*

	Contents, etc.	Dose.	Properties, etc.
Liquor Ammonii Acetatis	Dil. $\overline{Ac}$ + Ammon. Carb.	f℥ss	
" Arsenici Chloridi .	As_2O_3 gr. iv to f℥j	♏iij to x	Alterative.
" " et Hydrarg.			
" " Iodidi .	AsI_3 + HgI_2 in aq	♏ v	do
" Calcii Chloridi . .	℥j to f℥iss aq	♏ xx	do
" Ferri Chloridi . .	gr. 38 to f℥j	♏ ij to v	Astringent.
" " Citratis . .	℥ss $Fe_2O_3\overline{Cl}$ in f℥j		
" " Nitratis . .	$Fe_2 6NO_3$ in aq	♏ x	Tonic astring't.
" " Subsulphatis	An excess of Fe_2O_3		Styptic, but not caustic.
" " Tersulphatis	69 grs. Fe_2O_3 in f℥j		Used to precip. $Fe_2O_3H_2O$.
" Hydrargyri Nitratis	Strong sol., sp. gr. 2.165		To prepare Ung. Hydr. Nitrat.
" Iodinii Compositus	I gr. xxiiss + KI gr. xlv to f℥j	♏ v	Alterative, resolvent.
" Magnesii Citratis .	$Mg_3\overline{Ci}$ + Syrup, etc.	1 bott.	Cathartic.
" Plumbi Subacetatis	PbO in excess		In making lead water.
" " Subacet. dilut.	f℥iij to Oj aq		Sedative, externally.
" Potassii Arsenitis .	As_2O_3 gr. iv to f℥j (col'd)	♏ x	Alterative.
" " Citratis .	$2KHCO_3 + \overline{Ci}$ + aq	f℥ss	Refrigerant.
" Sodæ Chlorinata .	Calx Chlorinata + $NaCO_3$		Antiseptic.
Syrupus Ferri Iodidi . .	FeI gr. xlviii to f℥j syrup	♏ xv	Tonic alterative.

c. *of Gases.*

	Contents, etc.	Dose.	Properties, etc.
Aqua Acidi Carbolici . .	Glycerite of Carbolic Acid	f℥x to Oj	Antiseptic.
" " Carbonici . .	5 vols. CO_2 in aq	ad. lib.	Grateful vehicle.
" Chlorinii	Saturated with Cl		Disinfectant.
" Ammoniæ Fortior .	26 per cent. NH_3 sp. gr. .900		Caustic, Epispastic.
" Ammoniæ	10 per cent. NH_3 sp. gr. .96		Rubefacient.

Class 2d.—*In Alcohol.* (*Spiritus, Tincturæ, etc.*)

	Contents, etc.	Dose.	Properties etc.
Spiritus Ammoniæ . . .	Caustic NH_3 in Alcohol	♏ xx	As a solvent, etc.
" " Aromaticus	Carbonate and Aromatics	f℥ss	Antacid, stimulant.
Tinct. Ferri Chloridi . .	Fe_2Cl_3 in Alcohol	♏ xx	Tonic. Hæmatic.
" Iodinii	℥ss I to f℥j Alcohol		Externally, discutient.
" " Comp. . .	gr. xv I + gr. xxx KI to f℥j	♏ xv	do
Linimentum Saponis Camph.	Soap, Camph. and Stim. Oils		do stimulant.

Class 3d.—*In Wine.*

	Contents, etc.	Dose.	Properties, etc.
Vinum Antimonii . . .	gr. ij Tart. Ant. et Pot. to f℥j	f℥j	Sedative. Diaphoretic.
" *Ferri*	Citrate or Tartrate	f℥ij	Tonic.
" *Ferri et Quin. Citrat.*	Citrate, Quinia, and Iron	f℥ij	Tonic.

CLASS 4TH.—*In Ethers.*

	Contents, etc.	Dose.	Properties, etc.
Collodium	Nitrated Cotton in Ether		Externally, a vehicle.
Liquor Gutta Perchæ . .	In Chloroform		A soothing film.

See also Linimenta, Collyria, etc.

FILTRATION AND STRAINING.—The object of this process is to separate any undissolved or precipitated substance suspended in a liquid from the liquid itself. When the liquid is viscid, and contains only motes of an appreciable size, as, for instance, when a syrup has been prepared from sugar contaminated with insoluble impurities, a sufficient filter may be constructed of flannel or Canton flannel by folding over a square piece in the manner indicated in the figure, the line *c d* being laid over the line *c a*, and united by a seam; the

Fig. 185.

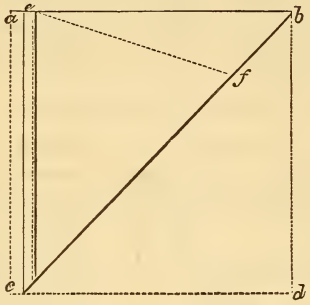
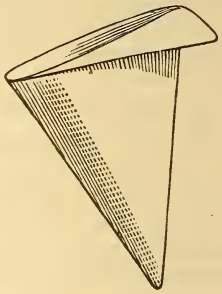


Fig. 186.



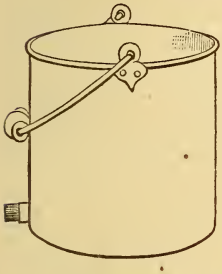
Flannel strainer.

bag thus formed is pointed at *c*, and open from *a* to *b*, the line *a c* being lapped over to form the seam. In using this strainer, the long end projecting toward the point *b*, beyond the dotted line *e f*, may be turned over the side of the vessel, by which the strainer will be kept in its place while the liquid is poured into the opening at the top.

In small operations this may be superseded by stretching a piece of flannel or other suitable material over the top of a funnel, and pouring the liquid upon it. With a viscid material this will only partially succeed, especially if the strainer sinks into direct contact with the sides of the funnel. In chemical processes the method of stretching a strainer across a square wooden frame, and suspending this over an open vessel, is resorted to, but without the advantage of pressure which is obtained by the use of the deeper conical bag. Bags of felt may be obtained of the hatters, which are very well adapted to the filtration of oils; their shape fits them to being suspended over the receiving vessel, properly protected from the dust.

Figs. 187 and 188 represent an apparatus I have been using for some time past for straining syrups. Fig. 187 is a tin bucket into which a funnel-shaped wire support, Fig. 188, is suspended, resting

Fig. 187.



Apparatus for straining syrups, etc.

Fig. 188.

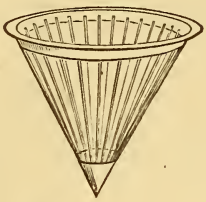
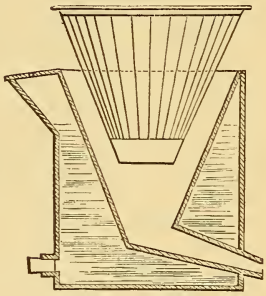


Fig. 189.

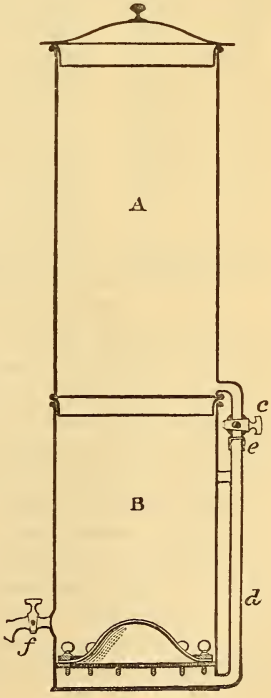


Physick's jelly strainer.

on the bucket by a projecting rim at the top; a jelly bag is here unnecessary, as a sufficiently large square or round piece of flannel laid upon the wires will assume a convenient position for use.

Fig. 189 represents in section a contrivance for straining jellies, attributed to the late Dr. Physick, and made by Isaac S. Williams, of Philadelphia. A wire support fits into a funnel, which is soldered into a vessel designed to be kept full of hot water, so as to prevent the cooling and thickening of the jelly during straining.

Fig. 190.



Warner's oil filter.

Fig. 190 exhibits a filter for fixed oils, also well adapted to viscid liquids and syrups. The upper cylindrical vessel of tinned iron, A, is about 22 inches high and 10 inches in diameter, with a flanch rim soldered on the bottom, of rather less diameter and about an inch wide, so as to fit firmly into the open top of another cylindrical vessel B, of the same diameter, 18 inches high. The upper vessel is furnished with a lid, and with an L-shaped tube and stopcock *c*, which penetrates the side close to the bottom, and fits into another tube *d* at *e*, which tube opens into the lower vessel close to its base, and is further secured to B by a tubular stay. The filtering medium is a cone of hat felt, projecting upwards from near the bottom of the lower vessel. This is arranged on a projecting ledge, penetrated with six holes with threads cut in them, in which fit pointed

thumb-screws with shoulders. On this ring fits a similar one of somewhat less diameter, furnished with corresponding holes, through which the thumb-screws readily pass as far as the shoulders, and are thus capable of binding the two rings closely together. The felt filter, having been cut to the diameter of the vessel, is slipped down so as to rest evenly upon the lower ring, the upper is then placed over it so as to avoid overlapping of the felt, and then the thumb-screws, being pressed through the felt, are securely screwed into the lower ring, which binds the rings so closely as to make a tight joint; the lower vessel is also supplied with a stopcock at *f* to draw off the filtered oil. The stopcock *c* being closed, the upper vessel is fitted in its place, and the tube joint *e* rendered tight by wrapping with isinglass plaster; when this is dry the upper vessel is filled with the oil and the stopcock *c* opened. The apparatus should be placed near a source of heat, so that it may reach 120° F., and as the filtered oil accumulates above the felt, it should be drawn off so as not to retard the process. The advantage is gained in this apparatus of the impurities settling away from the filter rather than accumulating upon it. It is the invention of William R. Warner, of Philadelphia. One of this size is capable of filtering a barrel of oil in a day.

Fig. 191.

All the advantages of this apparatus may be obtained and the upper vessel done away with, by attaching a pipe to a barrel or any other vessel in which the oil is kept, it having been raised to a shelf or some place high enough to give a pressure adequate to force the oil through.

A most useful strainer where large quantities of syrup are to be strained is made of cotton flannel by sewing it into the shape of a long bag, terminating in a point, to the inner surface of which at the point a strong tape loop is sewed. When used the larger end is bound securely to a wide-mouthed tin funnel, and this rests upon the top of a tall cylinder of tin, or is supported in a barrel near the top, the loop is drawn up to the top of the funnel and a bar of wood is slipped through it, the ends resting upon the sides of the funnel. In this way a very large extent of filtering surface is obtained, which being kept from the cooling effects of the atmosphere and from currents of air, no loss is sustained by evaporation. The accompanying figure shows a section of this apparatus.

This process is called *straining*, though a kind of filtration. In pharmacy, infusions, decoctions, syrups, fixed oils, and melted ointments are subjected to it in order to separate foreign ingredients. They pass through the strainer with much greater facility when quite hot, though in the case of the fixed oils and syrups, clearer products are obtained by conducting the operation in the cold, and by using several thicknesses of flannel, or by employing

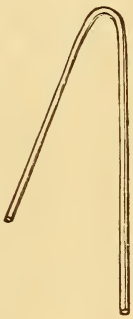
Canton flannel with the nap on the inside. Coarse linen is sometimes better than flannel, especially when considerable pressure is to be employed, as in extracting the juice from the pulp in making fruit syrups.

Straining differs from clarification in its mechanical action. The latter term is applied where the impurities to be separated are deposited on account of their greater specific gravity, or by being rendered heavier by the application of heat, or where, by the addition of a foreign substance, they are aggregated together and separated as a coagulum.

When the precipitate is heavy, or the coagulum obtained is sufficiently compact to be readily removed from the surface, the liquid may be poured off clear, frequently to almost the last drop, by the aid of a precipitation jar. The same object may be attained by the use of a well chosen wide-mouth packing bottle, with a round shoulder, into the concavity of which the precipitate subsides, while the liquid is quietly poured off. In separating a clear

Fig. 192.

Fig. 193.



supernatant liquid from a deposited precipitate, or for drawing off liquids from vessels ill adapted to decantation, a siphon (Figs. 192 and 193) may be advantageously employed.

The mode of using this instrument is to insert the shorter leg in the liquid, to apply the finger to the open end of the longer leg, and then draw the whole tube full of the liquid by sucking at the mouth-piece; when this is done, the finger is withdrawn, and the liquid will commence to flow, and continue till it reaches the same level in the receiving vessel that it has in the other. This current is caused by the unequal weight of the columns of liquid in the two limbs of the siphon. An instrument of this kind may be replaced by an ordinary bent tube, one end of which enters a common long-necked farina cologne bottle, at its largest diameter, the bottom having been evenly cracked off. The connection is made tight by a cork perforated to receive the siphon tube, and a shorter one to be used for sucking the air; in filling it, the

mouth of the bottle will then be the orifice through which the liquid will flow out when in action, and must of course be lower than the other leg, immersed in the liquid.

The plain siphon (Fig. 193) is constructed by simply bending an ordinary piece of glass tube of the requisite size over a spirit or gas lamp. The inconvenience in its use arises from the difficulty of filling it with the liquid beforehand. It might be filled with water, but that would dilute the preparation. If a small quantity has been already drawn off, the siphon may be filled by inverting it, and pouring into its long end from a graduated measure, then applying the end of the finger to prevent its running out, and inserting the short limb in the liquid to be drawn off.

These instruments are made of glass or metal, or an ordinary flexible tube of elastic gum will serve a good purpose, with the advantage which its flexibility secures of conducting the liquid into any receiver, provided it is lower than the containing vessel.

Some further uses of siphons will be found in the Preliminary Chapter on Inorganic Chemicals. Part III.

For ordinary aqueous, alcoholic, and ethereal liquids, the process of *filtration*, employing the term in its more limited sense, is used, the filtering medium being paper. The best filtering paper is made from cotton or linen rags, and is porous and free from any kind of glazing; the kind taken from woollen materials seems better adapted to viscid liquids, being thicker and more porous, but seldom free from coloring matter. It is, also, more soluble in alkaline solutions, and unfit for filtering such. Good filtering paper for delicate analytical processes should contain no soluble matter, and should not give more than $\frac{1}{250}$ to $\frac{1}{300}$ of its weight of ashes; soluble matter, if present, may be removed by washing it, first with very dilute hydrochloric acid, and secondly with distilled water.

Fig. 194.

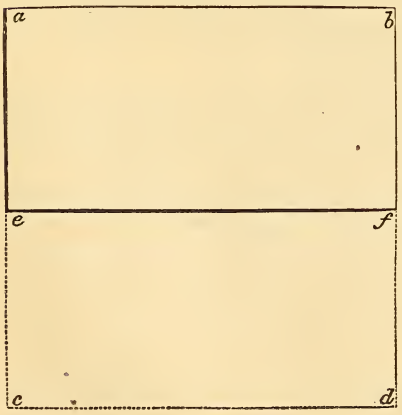
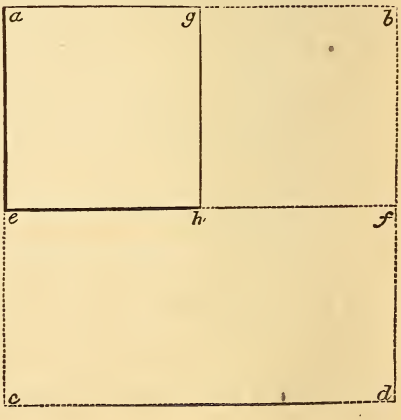


Fig. 195.



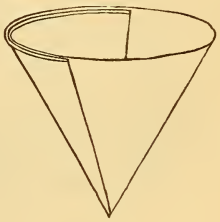
The construction of paper filters is an extremely simple thing when once learned, and is easily taught the student by a practical demonstration; it is, nevertheless, a difficult thing to describe clearly without giving to it more space than may appear at first sight due to so small a matter.

There are two kinds of paper filters, the *plain* and *plaited;* the latter of which is to be preferred, the chief advantage of the plain filter being where we desire to collect the solid ingredient present in the liquid, and to remove it afterwards from the paper; owing to its being so readily folded, it is in very common use.

The method of folding the plain filter is similar to the first steps to be taken in folding the plaited filter. In the following description I have endeavored to convey an idea of this process.

A square piece of filtering paper, *a b c d* (Fig. 194), is folded over in the middle, so as to form a crease at the line *e f;* the edge *c d* being laid directly over *a b*. The parallelogram, *a b e f*, represents the paper thus folded; the line *b f* being now laid upon the line *a e*, a crease is formed as represented by the line *g h* (Fig. 195); the folded paper, if opened, makes a cone, having the point *h* at its base, and by cutting off the projecting angle *a*, by a curved line from *e* to *g*, a plain filter will be the result, as shown in Fig. 196.

Fig. 196.



The *plaited filter* is made as follows: Take the paper before being cut, as above, and having opened it again so as to expose the parallelogram, the line *e h* (Fig. 197) is laid upon the line *c h*, forming a crease at *a h*. This being opened again, the line *e h* is laid upon the line *a h*, producing an additional crease at *g h* (Fig. 198). The crease *j h* (Fig. 199) is next to be formed by folding *a h* upon the middle dotted line (Fig. 199), as shown in Fig. 200.

Fig. 197.

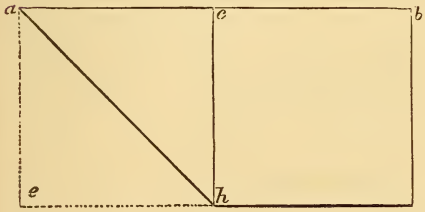
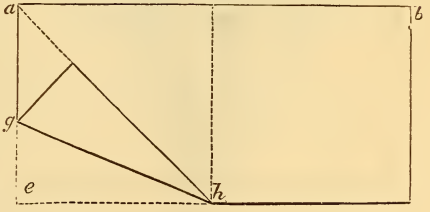


Fig. 198.



One-half of the parallelogram having thus been creased, we proceed to form on the other the corresponding creases *m h*, *b h*, and *k h* (Fig. 201), all of which are in one direction, forming receding angles. The next thing to be done is to divide the eight sections thus formed by a crease through each in the opposite direction. To do this, the edge *f h* is laid on crease *b h*, and then turned back, as

shown in Fig. 202, producing the crease *n h*. In the same way an intermediate crease is formed in each of the spaces. This is better

Fig. 199.

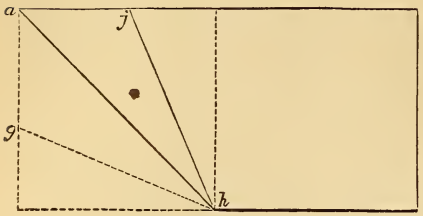
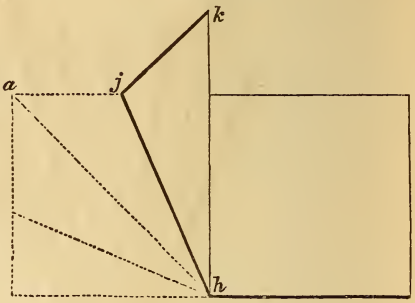


Fig. 200.



accomplished by turning the paper over, so that each of the receding angles shall project upward, and in this way be more readily brought

Fig. 201.

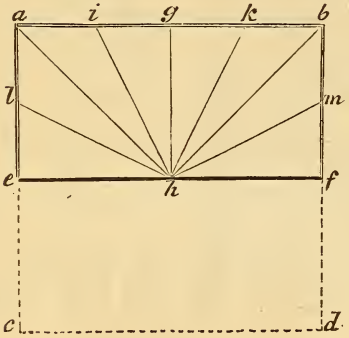
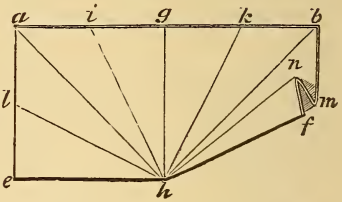
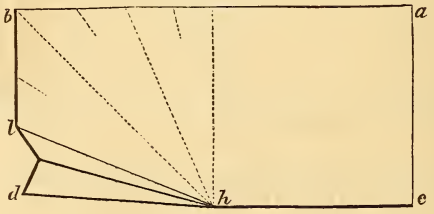


Fig. 202.



together, as shown in Fig. 203, producing a receding angle in forming the intermediate creases.

Fig. 203.



The paper will now have the appearance of a fan, represented by Fig. 204, folding it up in each of its creases like a shut fan (Fig. 205). The projecting points, *a* and *b*, should be clipped off with a

Fig. 204.

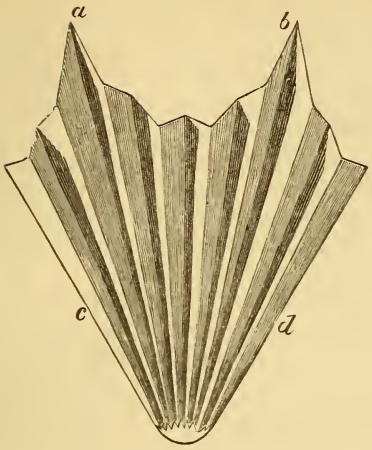
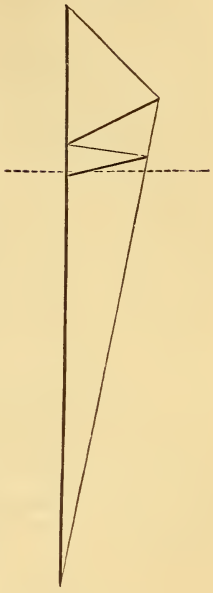
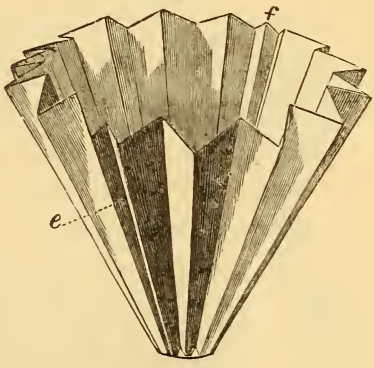


Fig. 205.



pair of scissors at the dotted line, so that when introduced into the funnel the filter should not project above its upper edge, otherwise the projecting paper will absorb the liquid by capillary attraction, and induce a constant evaporation, if the liquid be volatile, or prevent the complete washing out of soluble substances. Upon opening the originally doubled halves made by the first fold at *e f* (Fig. 194), it will be found to present the appearance indicated in Fig. 206.

Fig. 206.



In the filter, as thus constructed, the creases occur alternately, except near the line *e f*, where the two creases occurring next each other are in the same direction. Sometimes, to obviate this, the space intervening between these is folded backwards, as shown in the figure, so as to make a narrow crease in the opposite direction.

The plaited filter, as thus formed, is exceedingly useful for general purposes, exposing the entire surface of the paper to the action of the liquid, and favoring its unobstructed passage into the neck of the funnel.

A funnel, such as described and figured in the Preliminary Chapter, is employed for supporting a filter of either kind, and is, as there stated, better adapted to ordinary use when grooved on its inner surface, so as to allow the free downward passage of the liquid, after it has permeated the paper, and a groove on the out-

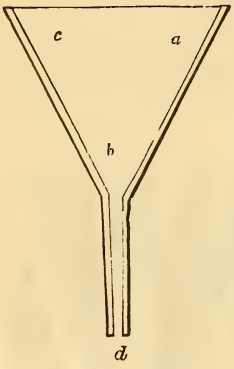
side of the tube, so that, when inserted tightly into the neck of a bottle, the air within may find ready egress.

If the tube of the funnel is smooth and ungrooved, a small plugget of folded paper, a piece of thick twine, or a small wedge-shaped splinter of wood, should be inserted in the neck of the bottle, along with the tube of the funnel; this will obviate one of the most common annoyances connected with filtration.

In filtering into an open vessel, it is well to place the lower extremity of the funnel in contact with the side of the vessel, thus preventing any inconvenience from the liquid splashing on the sides or over the top, and by creating a downward stream, promoting the free and rapid passage, of the filtrate.

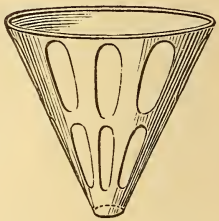
The paper of which the filter is formed, especially if very porous, is liable to be weakened by being plaited as above described; it is therefore advised not to make the creases firmly down to the very point, but rather to leave the terminus of an undefined shape; and when there is danger of breakage, either from the great weight of the liquid or from the weakness of the paper at its point, a very small plain filter may be advantageously placed under the point at the lowest extremity of the funnel; this is called a cap, and acts as a support to the weakest and most exposed part of the filter.

Fig. 207.



Section of a well formed funnel.

Fig. 208.



Filter support.

The proper shape of a funnel for filtration is shown in section at Fig. 207. The lines *a b* and *c b* are straight, and *a b c* and *a c b* are angles of 60°, making an equilateral triangle, into which the filter just described will fit perfectly.

In consequence of the unequal degree of firmness of the different creases, some of these are liable to float up from the sides of the funnel, to obviate which a filter weight has been invented, which consists of a wire frame of the shape of the funnel, and with a wire for each crease; this is laid upon the filter, and keeps it perfectly in its place.

Fig. 208 is a filter support adapted to the rapid passage of liquids in filtration; it, however, requires to be used in connection with an

open or wide-mouth receiving vessel or a funnel, otherwise the liquid might not be perfectly collected as it passes downwards.

The filtration of small quantities of liquid, as in chemical experiments, may be performed without a funnel or filter support by inserting a plain filter directly into the open top of a beaker glass or other open vessel, or into a ring of glass or earthenware laid on top of an open vessel; a filter of this kind, that will hold one fluid-ounce, will filter many ounces of certain liquids in an hour.

When paper filters are of large dimensions, or used for fluids which soften the texture of the paper, or for collecting heavy powders or metallic precipitates, they may be supported on linen or cotton filters of similar shape. This is best done by folding the cloth with the paper, and in the same way as would be done with doubled paper, observing to place them in the funnel so as to be in perfect contact toward the bottom.

An ingenious filter, invented by E. Waters, Troy, New York, consists of a circular sheet of paper of double thickness, composed of loose cotton and woollen fibre, and contains a piece of lace about four inches square covering the point of the filter; this is introduced between the sheets when they are "couched," so that the pulp unites through the meshes of the lace, and thus effectually overcomes the difficulty of breaking. An additional process discovered by the inventor obviates the liability to break at the point by being folded, a difficulty which is increased in proportion to the thickness of the paper.

Oils are filtered on a small scale in the way already described for other liquids, but in large quantities may be passed through felt hat bodies, which are to be had in the large cities generally, or through bags of Canton flannel, which are usually made about twelve or fifteen inches in diameter, and from four to eight feet long. These may be inclosed in bottomless casings or bags of coarse canvas, about five to eight inches in diameter, for the purpose of condensing a great extent of filtering surface into the smallest possible space. Several of these bags secured on the inside to the bottom of a tinned cistern are inclosed in a closet with suitable arrangements for maintaining a slightly elevated temperature, though this is not always desirable, and the oil is introduced from above, and collected as it passes from the filter. For further particulars on the filtration of oils, etc., see *Cooley's Cyclopœdia of Practical Receipts*, London, 1856.

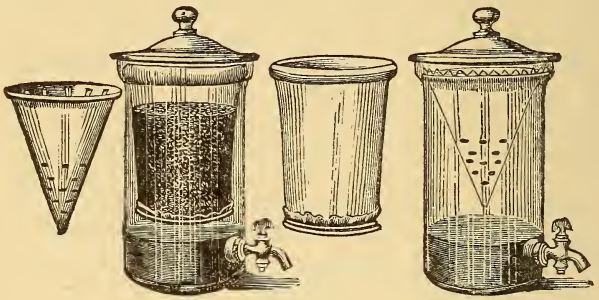
Fig. 209.

Filter for volatile liquids.

In filtering very volatile liquids, particularly in hot weather, some contrivance must be resorted to to prevent evaporation from the wide surface exposed, while, at the same time, the escape of air from the receiving vessel must be provided for. The drawing here given (Fig. 209), from

Mohr & Redwood, represents an arrangement of the kind. The glass funnel is fitted by a cork into the receiving vessel; its top is ground to a smooth surface, on which is laid a plate of glass, *c;* a little simple cerate will furnish a good luting; *b* is a very small glass tube laid down the inside of the funnel between it and the filter, and so twisted at its lower end as to be supported in its place; this forms a connection between the air below and that above the liquid, without allowing any evaporation. A very generally useful apparatus for this purpose, and for percolation

Fig. 210.



Filtering and percolating apparatus.

also, is the filtering and percolating apparatus of Mr. E. H. Hance, shown in Fig. 210; it consists of a cylindrical vessel of glass, stoneware, or tin, having a lid which can be rendered air-tight, and has a flange near the top upon which the funnel or percolator can rest; a faucet at the side near the bottom enables the operator to draw off the liquid when desirable.

The use of a guiding rod in pouring liquid upon a filter is found a great convenience; a glass rod is well suited to this purpose. The lower extremity is directed against the side of the filter near the apex, while the middle portion is placed against the mouth of the vessel, as shown in the drawing; by this means the stream is made to fall steadily, and not with too great force, and against the strongest part of the filter; the liquid being poured is also prevented from running back upon the containing vessel, and thus wasting, a very annoying circumstance, which is especially liable to occur when the vessel, whether a flask, a vial, or an evaporating dish, is furnished with no lip, or a very poor one, for pouring.

Fig. 211.

Pouring with a guiding rod.

A useful precaution in pouring liquids from bottles may be mentioned in this connection. It nearly always happens that the last

drop or two of the liquid being poured remains on the lip of the bottle, and is liable, if the lip is ill formed, to run down the outside; this may be obviated by touching the stopper to the edge where the liquid is collected, thus transferring this drop to the end of the stopper previous to inserting it in the neck of the bottle.

Much of the filtration in pharmacy has for its object the separation of the insoluble ligneous portions of vegetable medicines, after they have been sufficiently macerated. A practical difficulty in this case is deserving of mention here. If a measured portion, say one pint of liquid, has been macerated with two, four, or six ounces of a vegetable substance for the purpose of making a tincture or infusion, and, after the proper lapse of time, the whole is thrown upon a filter, the clear liquid that will pass will measure as much less than a pint as the vegetable substance holds by its capillary attraction. In order to obtain the whole quantity desired, some have diluted the filtered liquid till it reached precisely the required measure; but by the discovery of the principle of displacement (*see* Chapter VI.), it is found that an additional portion of liquid, if presented to the saturated powder, under favorable circumstances, will displace the portion of the original menstruum remaining in its pores. To secure this is more important from the fact that it is usually most highly impregnated with the active principles of the plant; and, therefore, in transferring the macerated preparation to a filter, the swollen mass of powder should be carefully compacted into the filter, and after the liquid has drained off, a fresh portion of similar liquid should be added till the preparation measures the quantity originally intended.

CHAPTER IV.

THE MEDICATED WATERS.

Aquæ, *U. S. P.* (Aquæ Medicatæ, *U. S. P.* 1850.)

These are generally solutions in water of the essential oils, made by triturating the latter with a third substance (carbonate of magnesium, usually), which, either by dividing them mechanically, and thus presenting them to the water under favorable circumstances, or by a chemical union with them, renders them soluble to a limited extent, and imparts their sensible properties to the medicated waters thus formed.

A better result is often obtained by mixing the fresh herb with a quantity of water in an apparatus for distillation, and allowing them to remain in contact until the water has, to a certain extent, dissolved out the essential oil, extractive matter, coloring principle, etc., and then, by the application of heat, volatilizing the water and the essential oil, and collecting them in a refrigerated receiver.

If the oil is in excess, it will be found, on standing, to collect on the surface of the liquid in the receiver, but a certain amount is retained in solution by the water, imparting to it the fragrance peculiar to the herb employed. There are undoubtedly other volatile principles present in odorous plants besides the essential oils, for without exception medicated waters prepared directly from the plant by distillation, possess milder and more pleasant properties than when prepared from the corresponding essential oils.

When distilled in tin condensers, these preparations are contaminated with small portions of the metal, which they deposit by age. (*See* chapters on Distillation and on Essential or Volatile Oils.)

In the preparation of extemporaneous solutions or mixtures, the medicated waters are very convenient; but where the one required is not at hand, it may generally be substituted by dropping the essential oil on a small piece of sugar, or, if in a mixture containing gum, upon the powdered gum, and triturating with a sufficient quantity of water. The proportion of the oil used, as shown in the table, is in all cases, excepting that of the bitter almond water and creasote water, one minim (frequently replaced by two drops) of the oil to one fluidounce of the liquid.

Aquæ.

(Unofficinal in Italics.)

First Class.—*Prepared by trituration with Carbonate of Magnesium (except Aq. Creasoti), which is afterwards separated by filtration.*

Officinal name.	Proportion.	Uses and doses.
Aqua acidi carbolici	ʒx glycerite of carb. acid in Oj	Antiseptic.
" camphoræ	ʒij to Oij = 2.13 grains to fʒj	Variously used, fʒss.
" amygdalæ amaræ	♏ xvj oil to Oij = 1 drop to fʒj	Nervous sedative, fʒss.
" anisi	♏ xv oil to Oj = 2 drops to fʒj	Aromatic adjuvant, fʒj
" cinnamomi	do. = do.	do. do.
" fœniculi	do. = do.	do. do.
" menthæ piperitæ	do. = do.	do. do.
" " viridis	do. = do.	do. do.
" creasoti	fʒj to Oj = 6 drops to fʒj	Antiseptic, fʒij, and as a lotion.
" chlorinii	fʒj should oxidize gr. x $FeSO_4 7H_2O$	

Second Class.—*Prepared by distillation from the drug which has been macerated in water.*

Officinal name.	Proportion.	Uses and doses.
Aqua rosæ	ʒxij to Oiv, distil. Oij	Vehicle in collyria.
" *sambuci*	℔iss to Oiiss, distil. Oss	do. do.
" aurantii florum	ʒxij to Oiv, distil. Oij	Sedative adjuvant, fʒss.
" *lauro-cerasi*	℔j to Oiiss, distil. Oj	Nerv. sedative, fʒss to fʒj.
" cinnamomi	ʒxviij to Cong. ij, distil. Cong. j	Adjuvant, sweet taste, fʒj.
" fœniculi	do. do.	do. little used, do.
" menthæ piperitæ	do. do.	Elegant carminative, do.
" " viridis	do. do.	do. do. do.

WORKING FORMULAS FROM THE U. S. PHARMACOPŒIA.

Aqua Acidi Carbolici, U. S. P. (Carbolic Acid Water.)

Take of Carbolic acid, ten fluidrachms.
Distilled water, a sufficient quantity.

Mix the glycerite of carbolic acid with a sufficient quantity of distilled water to make the mixture measure a pint.

Aqua Amygdalæ Amaræ, U. S. P. (Bitter Almond Water.)

Take of Oil of bitter almond, sixteen minims.
Carbonate of magnesium, sixty grains.
Distilled water, two pints.

Rub the oil, first with the carbonate of magnesium, then with the water, gradually added, and filter through paper.

Aqua Anisi, U. S. P. (Anise Water.)

Take of Oil of anise, half a fluidrachm.
Carbonate of magnesium, sixty grains.
Distilled water, two pints.

Rub the oil first with the carbonate of magnesium, and then with the water, gradually added, and filter through paper.

Aqua Cinnamomi, U. S. P. (Cinnamon Water.)

Take of Oil of cinnamon, half a fluidrachm.
Carbonate of magnesium, sixty grains.
Distilled water, two pints.

Rub the oil, first with the carbonate of magnesium, then with the water, gradually added, and filter through paper.

Aqua Fœniculi, U. S. P. (Fennel Water.)

Take of Oil of fennel, half a fluidrachm.
Carbonate of magnesium, sixty grains.
Distilled water, two pints.

Rub the oil, first with the carbonate of magnesium, then with the water, gradually added, and filter through paper.

Aqua Menthæ Piperitæ, U. S. P. (Peppermint Water.)

Take of Oil of peppermint, half a fluidrachm.
Carbonate of magnesium, sixty grains.
Distilled water, two pints.

Rub the oil, first with the carbonate of magnesium, then with the water, gradually added, and filter through paper.

Aqua Menthæ Viridis, U. S. P. (Spearmint Water.)

Take of Oil of spearmint, half a fluidrachm.
Carbonate of magnesium, sixty grains.
Distilled water, two pints.

Rub the oil, first with the carbonate of magnesium, then with the water, gradually added, and filter through paper.

Aqua Camphoræ, U. S. P. (Camphor Water.)

Take of Camphor, one hundred and twenty grains.
Alcohol, forty minims.
Carbonate of magnesium, half a troyounce.
Distilled water, two pints.

Rub the camphor, first with the alcohol, then with the carbonate of magnesium, and lastly with the water, gradually added; then filter through paper.

In making camphor water, the chief point to be observed is to secure the complete division of the camphor; this is accomplished by triturating it with alcohol, which brings it into a pasty mass; this mass must now be brought completely between the triturating surfaces of the pestle and mortar, for if any portion escapes it will be lumpy and granular, and not in a favorable condition for solution. The carbonate of magnesium may be triturated with the moist camphor before it has passed into the condition of a powder, and after thorough incorporation the whole may be passed through a fine sieve; the water is then gradually added. The undissolved carbonate and camphor should be thrown on the filter with the first portion of the liquid, so that it may be percolated by the liquid during its filtration.

A simple test for the waters prepared with carbonate of magnesium is a small portion of calomel triturated with the water in question. If made with carbonate of magnesium, a portion of the calomel is reduced to black oxide, showing with the calomel a brownish color; no such change takes place with distilled waters.

Aqua Acidi Carbonici. (See page 149, Carbonic Acid.)

Aqua Chlorinii. (See page 133, under head of Preparations of Chlorine.)

Aqua Creasoti, U. S. P. (Creasote Water.)

Take of Creasote, a fluidrachm.
Distilled water, a pint.

Mix them, and agitate the mixture until the creasote is dissolved.

Creasote water is a new officinal in the *U. S. Pharmacopœia* of 1860; the comparative solubility of the oil in water obviates the necessity for trituration as in the other instances. Creasote is adapted to both internal and external use in a great variety of cases detailed in works on therapeutics and the practice. This preparation is stronger than the creasote water heretofore in general use, and though adapted to many external applications, it should be somewhat diluted for use internally, as in excessive nausea, for which it is in much esteem.

REMARKS ON SECOND CLASS.

(*See* Chapter on Distillation.)

Rose-water is very much employed in prescription for the preparation of solutions of nitrate of silver, as a substitute for distilled water. It should be remembered, however, that it is not as desirable a solvent for the silver salt as pure distilled water. This

practice may have arisen from the comparative scarcity of distilled water in former times, while distilled rose-water was easily obtained. It is liable to undergo a change, depositing a sediment, and becoming quite sour if long kept, especially in warm weather. On this account, and in consequence of the greater facility and cheapness of the process, some pharmacists make rose-water in the same way as the other medicated waters, by triturating the oil or attar of rose with magnesia, and then with water, and afterwards filtering. The proportions usually employed are four drops of the oil to a pint of water; when made in this way, however, it is not so well adapted to the uses above mentioned, though suitable for flavoring pastry.

The *Pharmacopœia* directs that 48 troyounces recent pale rose and 16 pints of water be mixed, and 8 pints be distilled off.

It is important in making it by this process to guard against confounding the genuine attar of rose with oil of rose geranium, and other substitutes.

The most conspicuous instance of the superiority of distilled over ordinary triturated medicated waters, is furnished by *cinnamon-water*, which, when made by distilling from Chinese or Ceylon cinnamon, possesses a decidedly sweet taste, while that from the volatile oil is more pungent, and destitute of sweetness to the palate.

The Distilled Water of Elder Flowers is a very delicate vehicle for saline substances in solution for *collyria*. It is much used in Europe, but is seldom kept by our pharmacists, rose-water being used for the same purpose.

Orange-flower Water.—A well-known and delightful perfume, imported from France and Italy, and obtained by distillation from the flowers of the bitter orange tree. It is one of the most agreeable of flavors for medicinal preparations, though, until recently, confined almost entirely to the purposes of the perfumer. This is sometimes imitated by dissolving the oil of neroli of commerce in water, which furnishes a poor substitute for the true article. According to Gobly, this sophistication may be detected by the distilled water of orange-flower producing a rose color on the addition of 1 part of sulphuric and 2 nitric acid to 3 of water. Its sedative effects, which are not generally known in this country, and not noticed in our works on materia medica, adapt it especially to use in nervous affections. In doses of a tablespoonful it is found to allay nervous irritability and produce refreshing sleep. The same proportions and method are directed for this preparation as for rose-water.

Peach Water, which is chiefly used as a flavor in cooking, is made by a similar process from the leaves of the *Persica Vulgaris s. Amygdalis Persica*. It is generally superseded, though not without disadvantage, by the officinal *aqua amygdalæ amaræ*.

Cherry-laurel Water, officinal in some of the European Pharmacopœias, is directed to be made by distilling one pound of fresh-bruised leaves of cherry-laurel with water till one pint (Imperial measure) of the distilled water is obtained. To this the Edinburgh College directs the addition of an ounce of comp. spt. of lavender,

to distinguish it in color from common water. This preparation is recently much prescribed, in doses of thirty minims to a fluidrachm, as a sedative narcotic. It contains a varying proportion of hydrocyanic acid, and deteriorates very much by keeping. The custom of substituting for this preparation the officinal water of bitter almonds is most unwarrantable, as the difference in composition and strength might lead to great inconvenience and disappointment. The mode of distinguishing them recommended is to add ammonia, which in bitter almond water produces a dense milkiness, while in cherry-laurel water it produces, after a time, only a slight turbidity. In view of the impossibility of obtaining cherry-laurel water fresh and reliable, I have adopted the following recipe for its artificial preparation, suggested by W. H. Pile:—

Take of	Diluted hydrocyanic acid, *U. S. P.*	f℥j.
	Ess. oil of bitter almonds	♏iij.
	Alcohol	f℥iij.
	Water	f℥iiss.—M.

The distilled *water of wild-cherry tree leaves* has been recommended as a substitute for cherry-laurel water, and if found by experience to correspond in its properties with the imported article, might be well substituted for it in the United States, where this tree is indigenous and generally diffused.

Under the name of *Aqua Tiliæ* a distilled water is used in Europe, obtained from the flowers and bracts of *Tilia Europea*, and considerably used as an adjuvant, mostly in diuretic and diaphoretic mixtures. The tree being naturalized in the United States, it would be easy to render it and probably our native linden useful in this form.

All the waters directed to be made by triturating their respective oils with carbonate of magnesium and water are directed by an alternative process to be prepared by distillation from the respective drugs, using, in every case but one, 18 troyounces of the drug, 16 pints of water, and distilling 8 pints. The exception is that of anise water, where 10 troyounces are used to the same quantity of menstruum, and 8 pints of distillate are to be obtained.

CHAPTER V.

ON MACERATION AND THE INFUSIONS.

There is a well recognized difference between the solutions treated of in the last two chapters, most of them effected by chemical processes, by simple contact of soluble materials with their appropriate solvents, and those now to be brought into view.

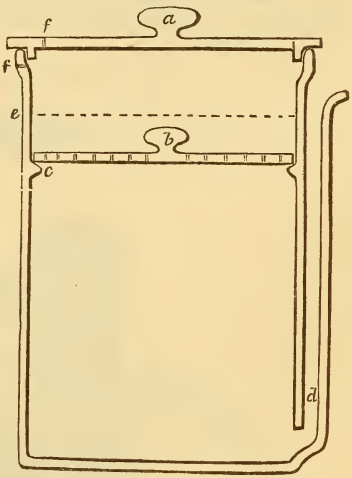
Organized vegetable structures, plants, and parts of plants, composed of proximate principles of varying solubility, some of which it is desirable to secure in the solutions formed, while others are to be rejected, require different and less ready modes of treatment.

As in the previous instances the reduction of the material to a more or less fine condition is the first step toward its preparation in a liquid form; after this the liquid, which in this case is called the *menstruum*, is to be brought into favorable contact with it.

When the quantity of the medical agent is small in comparison with the menstruum, as in most of the infusions, and where rapidity is not an object, the process of *maceration* is chiefly resorted to.

This is accomplished in a covered queensware vessel, a common pitcher or bowl, for instance, or sometimes in a tin cup or measure, care being taken, in the case of astringent infusions, to avoid the use of a defective tin or an iron vessel. Maceration consists in pouring the liquid upon the medicinal substance previously bruised or coarsely powdered, and allowing it to stand for a greater or less period of time according to circumstances. The longest period directed in the *Pharmacopœia* for infusions is twenty-four hours, as in the case of infusion of tar; the shortest, ten minutes, as in the case of infusion of chamomile. In preparing tinctures, wines, vinegars, etc., seven or fourteen days are generally prescribed.

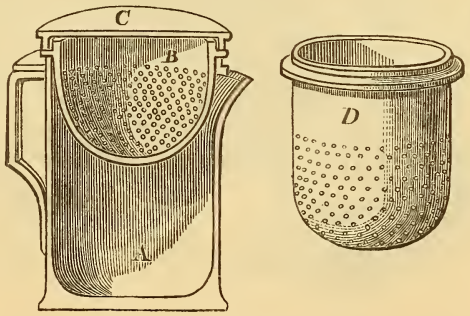
Fig. 212.



Section of Alsop's infusion mug.

Infusions are conveniently prepared in a vessel made for the purpose, here figured, called Alsop's infusion mug, which contains a perforated diaphragm, *b*, near the top, on which the substance to be macerated is placed; the liquid is introduced so as barely to cover

Fig. 213.



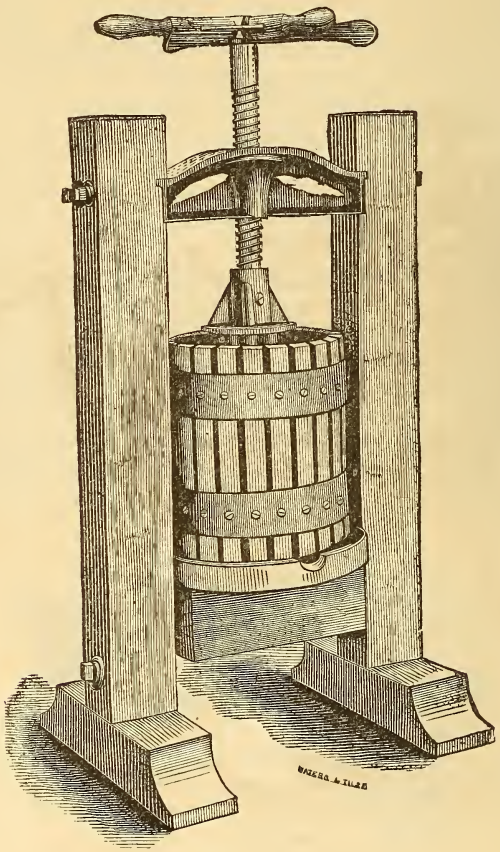
Section of Squire's infusion pot.

this, reaching, perhaps to the line, *e;* a circulation is thus induced and continued in the liquid, by which the least impregnated por-

tions are brought constantly in contact with the drug, and the most completely saturated portion, by greater specific gravity, sinks to the bottom.

Squire's Infusion Pot is an improvement on Alsop's; it is a neat pharmaceutical implement adapted to making the galenical liquid preparations generally. In Fig. 213, we have a section, *B* and *D*, being two cup-shaped perforated diaphragms, either of which may be used at pleasure. The vessel must be of such capacity that the substance placed on the diaphragm shall be under the surface of the liquid when properly filled. A modification of this is used in some large establishments for the preparation of tinctures; it has many advantages over ordinary apparatus for maceration, and is not unlike displacement in the beauty and efficiency of the preparations made in it.

Fig. 214.



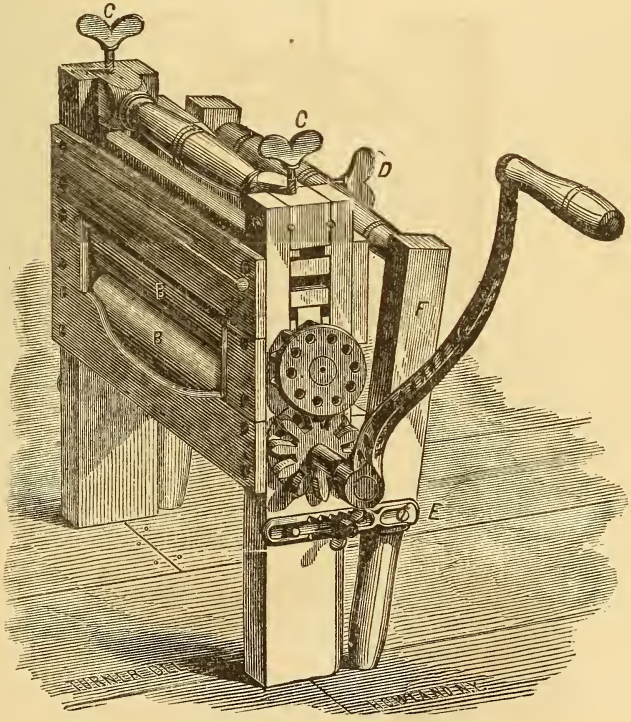
In preparing large quantities of tinctures or infusions by maceration, there is considerable loss of the saturated liquid unless a suitable press is used to obtain the last portions. The pattern,

Fig. 214, which is sold by Bullock & Crenshaw, of Philadelphia, price $10, is among the best in the market.

It is substantial, and permits the application of considerable force. The frame is oak, $3\frac{1}{2}$ inches square. The hopper is made of strong oak pieces separated $\frac{1}{8}$ inch from each other—the pieces are firmly held together by two broad iron bands, through which a screw passes into each piece, securing it in its place. The hopper is 11 inches high, and 8 inches in diameter, having a capacity of 3 gallons—it stands upon a circular base of oak, which is grooved to receive and collect the expressed liquid, and has a lip to discharge it. The screw is iron, with square thread, $1\frac{1}{2}$ inch diameter, and passes through a heavy iron casting. Both the iron head-piece and the support for the hopper are let into the oak uprights, and secured by heavy iron bolts.

In using the press, a press bag, having about the diameter of the hopper, should be used—the bag should be made of strong canvas of an open texture; or the hopper may be lined with clean straw,

Fig. 215.



Clothes-wringer press.

after the manner of the cider press. The hopper, being opened at both ends, and movable, is readily cleared of its contents and cleansed.

Jenk's Kitchen Press is a smaller and cheaper kind, sold by the

dealers in housekeeping articles, at a price varying from $1.75 for five-inch cylinders to $3 for eight-inch cylinders.

Fig. 215 exhibits an apparatus lately invented, and largely used as a household convenience for wringing clothes, and well adapted to straining infusions, or the pulpy masses of crushed fruit, from which the juice is to be extracted.

This apparatus is designed to be secured, when in use, upon a cedar tub or other convenient receptacle, by means of the upright wooden lever *E F*, which is connected by means of a galvanized iron crosspiece *E*, so constructed as to be lengthened or shortened at pleasure, with the body of the apparatus. To secure the lever tightly to the receptacle, the thumb-screw *D* is arranged to work upon the upper part of the machine. The pressing surfaces are two cylinders *B B*, covered with thick gum-elastic, the pressure of which upon each other is regulated by a wooden spring, not shown in the drawing, and by the screws *C C*, which play upon a movable beam above the springs. The force is applied by a crank and two cogwheels, which equalize the movement of the cylinders, a peculiarity of this machine, which gives it advantages over a kind of more simple construction. It is found that without this arrangement, one of the cylinders is apt to wear out before the other. The operation of this press is very simple and effectual; the mass to be pressed is diffused through a square canvas bag, which must be very strong, and drawn steadily between the rollers, moved by the crank; the liquid is very effectually expressed, and runs into the receiving vessel. This apparatus has been found particularly useful in pressing the juice from strawberries, currants, and similar fruits, and is used on a great scale in sugar refineries, for the "wringing out" of the felt strainers.

Digestion differs from maceration in being confined to elevated temperatures, yet below the boiling point of the menstruum; as the term is generally employed, it means maceration, with continued application of heat, and is nearly synonymous with "simmering."

The term *infusion* includes both maceration in its more limited sense and digestion. It is often applied to the ordinary mode of making infusions, which is to pour the hot liquid on the bruised drug, and allow it to remain until cool. In a recipe worded with due regard to accuracy, if we are directed to *macerate* for any given time, we infer that *cold* infusion is intended; if to *digest*, we understand that *hot* infusion is desired.

In making tinctures, digestion, though seldom directed, is ofter very useful, particularly where rapidity is an object, and where we wish to form a very concentrated preparation. These and infusions should be strained while hot, and dispensed together with the precipitate formed on cooling, which is a sparingly soluble compound frequently containing their active principles.

Of the proximate principles of plants, it may be remarked that hot water has the property of dissolving the starch, and cold water the vegetable albumen, and both dissolve the gum, sugar, extractive, and other principles liable to fermentation; the absence of any

antiseptic in infusions and decoctions renders them extremely prone to undergo change on exposure to the atmosphere.

When it is desirable to preserve these aqueous solutions for a longer period than a day or two, they should be bottled while hot, the bottle being filled completely and corked tightly, so as to exclude the air, and then set aside in a cold place in an inverted position. The addition of $\frac{1}{3}$ to $\frac{1}{8}$ quantity of alcohol, or of some tincture not interfering with the medical properties of the infusion, is recommended where not objectionable. The officinal compound infusion of gentian and infusion of digitalis are rendered permanent preparations by this means. The infusion of wild-cherry bark will keep for some days without any addition, owing to the antiseptic influence of hydrocyanic acid which it contains.

The following substances should not be prescribed mixed with or dissolved in infusions, being incompatible with one or more of the proximate principles usually present in them: Tartrate of antimony and potassium, corrosive chloride of mercury, nitrate of silver, acetate and subacetate of lead; in some cases, the alkalies, lime-water, and tincture of galls, and, in the instance of astringent infusions, the salts of iron.

When mixed with either of the tinctures made with strong alcohol, a resinous precipitate is deposited from the tincture, and the mixture, if strained, loses much of its activity; the same is the fact, to a less extent, with many of the tinctures made with diluted alcohol.

Many of the infusions which are clear when freshly prepared, become turbid soon after by the deposition of vegetable albumen, apotheme, and other insoluble principles; these precipitates are likely to carry down with them a portion of the active ingredients. The infusions of cinchona prepared by maceration with hot water do not become clear, even by filtration through paper.

Infusions made by maceration may frequently be poured off clear from the vessel in which they were prepared, leaving the dregs in the bottom; this, however, is always attended with the loss of the last portion of the liquid; they may be strained through a muslin or flannel strainer, and, by using a little force in expressing the dregs, very nearly the whole portion of liquid may be obtained, or this may be done more satisfactorily, by displacement, in filtering them.

This class of medicinal preparations is one of the least elegant in use, and is mainly confined, in the United States, to domestic practice. Even when prescribed by physicians, the infusions are generally made by the nurse or attendant upon the sick, rather than by the pharmacist. The infusions of cinchona bark, infusion of digitalis, compound infusion of gentian, and compound infusion of roses, form the chief exceptions to this.

The process of percolation, treated of in the next chapter, is applied with great advantage to some of these preparations, and, in a majority of cases, the substitution of cold water for hot, and of percolation for maceration or digestion, is found to produce a more

elegant and equally efficient infusion, and one which, from containing less coloring matter, fecula, resinous, and other inert principles, keeps better, and is more acceptable to the stomach.

When an infusion is intended as an emetic draught, or to promote the operation of emetics, or as a diaphoretic, it is usually given while hot, and, of course, to all such cases the above remark does not apply. Nor is it equally applicable to the demulcent infusions of flaxseed and buchu, although the former may be made very well with cold water, and is then less oily in its character.

The general dose of infusions is f℥ij, or a wineglassful, frequently repeated. This is to be varied in the case of infusion of senna, compound infusion of flaxseed, and others, in which a much larger quantity may be taken at a draught.

There are two of the officinal infusions which it would be improper to give in the above general dose; these are *infusion of digitalis* and *infusion of capsicum*, the doses of which are specially stated in the syllabus.

SYLLABUS OF INFUSIONS.

Infusa, *U. S. P*

First Group.—One Troyounce to a pint.

Infusum cinchonæ flavæ,	Cold water + arom. sulphuric acid f℥j.	Tonic.
" " rubræ,	Cold water + arom. sulphuric acid f℥j.	Tonic.
" cascarillæ,	Cold water (or boiling).	Stimulant; tonic.
" eupatorii,	Boiling water.	Tonic; diaph. emet. (hot).
" krameriæ,	Cold water.	Astringent.
" juniperi,	Boiling water.	Diuretic.
" pareiræ,	Boiling water.	Diuretic.
" buchu,	Boiling water.	Demulcent; diuretic.
" sennæ,	Boiling water + coriander ℥j.	Cathartic.

Second Group.—Half a Troyounce to a pint.

Infusum calumbæ,	Cold water (or boiling).	Tonic.
" angusturæ,	Cold water, do.	Stimulant; tonic.
" serpentariæ,	Cold water, do.	Tonic.
" pruni Virginianæ,	Cold water.	Tonic; nerv. sedative.
" anthemidis,	Boiling water.	Tonic; emetic when hot.
" humuli,	Boiling water.	Tonic; mild narcotic.
" catechu comp.,	Boiling water + cinnamon, ℥j.	Astringent.
" salviæ,	Boiling water.	Aromatic; astringent.
" capsici,	Boiling water.	Stimulant. Dose, ℥ss.
" valerianæ,	Cold water (or boiling).	Stimulant; antispasmodic.
" zingiberis,	Boiling water.	Carminative.
" lini comp.,	Boiling water + liquorice root, ℥ij.	Demulcent.
" spigeliæ,	Boiling water.	Anthelmintic.
" gentianæ comp.,	Cold water + alcohol, ℥ij, bitter orange-peel, ℥j, coriander, ℥j.	Tonic.

Third Group.—Proportions varied.

Infusum caryophylli,	℥ij to Oj boiling water.	Stimulant.
" quassiæ,	℥ij to Oj cold water.	Tonic.
" rhei,	℥ij to Oss boiling water.	Cathartic.

Infusum digitalis,	ʒj to Oss boiling water + tinct. cinnamon, fʒj.	Narcotic. Dose, fʒij.
" tabaci,	ʒj to Oj boiling water.	Sedative inj. in hernia.
" taraxaci,	ʒij to Oj boiling water.	Diuretic.
" rosæ comp.,	See formula.	Adjuvant; astringent.
" picis liquidæ,	do.	Expectorant; tonic.

As illustrations of the mode of preparing the foregoing infusions, the following officinal forms are selected:—

With Boiling Water.

Infusum Taraxaci, U. S. P.

Take of Dandelion, bruised, two troyounces.
Boiling water, a pint.

Macerate for two hours in a covered vessel, and strain.

Infusum Rosæ Compositum, U. S. P.

Take of Red rose, half a troyounce.
Diluted sulphuric acid, three fluidrachms.
Sugar, in coarse powder, a troyounce and a half.
Boiling water, two pints and a half.

Pour the water upon the rose in a covered glass or porcelain vessel; then add the acid, and macerate for half an hour. Lastly, strain the liquid, and in it dissolve the sugar.

Compound infusion of rose is said to be an excellent addition to Epsom salts in solution for overcoming its bitterness.

With Cold Water.

Infusum Cinchonæ Rubræ, U. S. P.

Take of Red cinchona, in moderately fine powder, a troyounce.
Aromatic sulphuric acid, a fluidrachm.
Water, a sufficient quantity.

Mix the acid with a pint of water. Then moisten the powder with half a fluidounce of the mixture, and, having packed it firmly in a conical glass percolator, gradually pour upon it the remainder of the mixture, and afterwards water, until the filtered liquid measures a pint.

Infusum Cinchonæ Flavæ, U. S. P.

Substitute cinchona flava, and proceed as in last formula.

Infusum Pruni Virginianæ, U. S. P.

Take of Wild-cherry bark, in moderately coarse powder, half a troyounce.
Water, a sufficient quantity.

Moisten the powder with six fluidrachms of water, let it stand for an hour, pack it gently in a conical glass percolator, and gradually pour water upon it until the filtered liquid measures a pint.

Infusum Gentianæ Compositum, U. S. P.*

Take of Gentian, in moderately coarse powder, half a troyounce.
Bitter orange peel, in moderately coarse powder,
Coriander, in moderately coarse powder, each, sixty grains.
Alcohol, two fluidounces.
Water, a sufficient quantity.

Mix the alcohol with fourteen fluidounces of water, and, having moistened the mixed powders with three fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them, first, the remainder of the menstruum, and afterwards water, until the filtered liquor measures a pint.

Infusum Picis Liquidæ, U. S. P. (*Tar water.*)

Take of Tar, a pint.
Water, four pints.

Mix them, and shake the mixture frequently during twenty-four hours. Then pour off the infusion, and filter through paper.

This is a new officinal in the edition of the *Pharmacopœia* for 1860, being placed under a different head from that to which common consent has heretofore assigned it. It is a useful preparation, and much in request as a remedy in pectoral affections.

With either Cold or Hot Water.

Infusum Valerianæ, U. S. P.

Take of Valerian, in moderately coarse powder, half a troyounce.
Water, a sufficient quantity.

Moisten the powder with two fluidrachms of water, pack it firmly in a conical percolator, and gradually pour water upon it until the filtered liquid measures a pint.

This infusion may also be prepared by macerating the valerian with a pint of boiling water, for two hours, in a covered vessel, and straining.

Unofficinal.

Dr. Mettauer's Aperient.

Take of Aloes (soc.)	℥v.
Bicarb. sodium	℥xj.
Valerian (contused)†	℥j.
Water	Oj.
Comp. spirit of lavender	f℥vj.

Make an infusion by maceration or percolation.

* *Compound Infusion of Gentian* is liable to separate a pectine-like precipitate, by standing, which interferes with its being dispensed conveniently. It is also rather bulky, which suggests its being prepared in the following concentrated form for extemporaneous dilution, as proposed by J. T. Shinn :—

Take of Gentian powder, two ounces.
Orange-peel powder,
Coriander powder, each, a half ounce.
Diluted alcohol, sufficient to make one pint.

By percolation, make a pint, of which one part is to be added to three of water to make the compound infusion.

† Some recipes omit the valerian.

Dose.—A tablespoonful containing about 9 grs. aloes, 20 of bicarb. of sodium, and 14 of valerian. As a laxative for constipation, etc.

Mistura Aloes Composita.—I. J. Grahame.

Recommended as a substitute for compound decoction of aloes of the *British Pharmacopœias.*

Take of Extract of liquorice	½ ounce.
Liquorice-root in moderately fine powder	1½ ounce.
Carbonate of potassium	1 drachm.
Aloes, myrrh, and saffron, in moderately fine powder, each	1½ drachm.
Compound tincture of cardamom	6½ fluidounces.
Distilled water	18 fluidounces.

Rub well together the aloes, myrrh, and carbonate of potassium; add the remaining powder, and mix all intimately. Having mixed the water and compound tincture of cardamom, pour of this liquid on the compound powder, sufficient to dampen it; pack moderately in a suitable displacer, and having placed over the surface a piece of perforated filtering paper, pour on the remainder of the liquid, and when it has ceased to pass, add water sufficient to make the filtrate measure in all twenty-four fluidounces. A clear, rich, reddish-brown liquid. (*Transactions Md. Col. Phar.*, 1858.)

Elixir Clauderi.

Take of Carbonate of Potassium	℥j.
Aloes	℥ij.
Guaiacum	℥ij.
Myrrh	℥ij.
Saffron	℥ij.
Rhubarb (contused)	℥ij.
Water	f℥xviij.

Macerate a few days and decant.

Dose.—A tablespoonful.

The concentrated infusions, of which several are in common use in England, properly belong to the class of fluid extracts, and under that head a recipe will be found for infusum cinchonæ spissatum, of the *London Pharmacopœia.*

Parrish's Cider Mixture.

Take of Juniper berries, Mustard seed, Ginger, each	2 ounces.
Horseradish, Parsley root, each	4 ounces.
Cider	1 gallon.

Macerate for a week and strain, or make by displacement, adding a little alcohol if designed to be kept long.

Dose.—A wineglassful three times a day, increased at discretion. In dropsy.

Black Draught.

Take of	Senna	℥ss.
	Sulphate of magnesium	℥j.
	Manna	℥j.
	Fennel seed	℥j.
	Boiling water	f℥viij.

Macerate in a covered vessel till the liquid cools.

Dose.—One-third, to be repeated every four or five hours till it operates.

Physick's Medicated Lye, or Alkaline Solution.

Take of	Hickory ashes	℥viij.
	Soot	℥j.
	Water	Cong. j.

Digest for twenty-four hours and strain.

Dose.—A wineglassful. In dyspepsia.

Processes Requiring Heat.

The generation and application of heat in pharmacy having been specially treated of as far as deemed necessary, we proceed to the consideration of the processes of decoction, evaporation, distillation, etc., and of the galenical preparations in which they are necessary.

Decoction, or boiling, is a process to be applied with care to vegetable substances in contact with water. Although boiling water, from its being permeated by steam, and from its being of less specific gravity, is more penetrating and dissolves many principles which resist the action of water at a lower temperature, it is, nevertheless, liable to disadvantages as a menstruum for the preparation of solutions from plants and parts of plants.

The boiling points of liquids, although constant under precisely the same circumstances, vary on account of increased or diminished atmospheric pressure, the greater or less depth of the liquid, and the nature of the containing vessel. Fluids boil at a lower temperature and more quietly in vessels with rough surfaces than in those which are polished; in glass vessels, especially, they display a tendency to irregularity of ebullition, and the boiling point of water, which, under ordinary circumstances, is at 212° F., rises sometimes as high as 221° in a vessel of smooth glass.

The boiling points of infusions rise in proportion to the amount of contained vegetable matter, and there appears to be a difference between the apparent temperature of a boiling solution, and the actual heating or scorching influence to which it is subjected by contact with the bottom and sides of the containing vessel. The steam generated at the point of contact being under heavy pressure in deep vessels, and temperature rising in proportion to pressure, it may be supposed at the moment of its formation to be much hotter than 212°, and if the portion of liquid immediately in contact with the heated vessel contains substances in solution liable to be burnt, such a result may occur during the moment consumed in

converting any portion into steam. In this way we may account for the well known injurious effect of boiling, upon vegetable infusions.

Starch is a proximate principle, present in a large number of vegetables; being inert and soluble in water at a boiling temperature, it adds to the viscidity of decoctions, and renders them disagreeable to the patient, without adding to their medicinal activity.

The extractive matter is more freely soluble in hot than in cold water, but the boiling temperature applied under ordinary circumstances produces the decomposition of this and other vegetable principles, or so modifies them as to impair their efficiency. The access of air seems to promote this result, and hence boiling in a covered vessel is preferable, except where the quantity of the solution is to be reduced by the process. In this case, by conducting the operation in a *still*, the surface of the liquid may be kept covered by the vapor, almost to the exclusion of the air.

A substance called *apotheme*, or *oxidized extractive*, is also deposited by vegetable solutions on boiling with access of air; this may carry with it a portion of the active principles, and should not be rejected from the preparation.

If the plant under treatment contains a volatile oil or other volatile principle which it is desirable to retain in the decoction, long boiling is inadmissible, especially in an open vessel.

Vegetable decoctions, if strained while hot, generally deposit a portion of insoluble matter on cooling, which may or may not contain active ingredients; but it is generally advisable to retain the precipitate and diffuse it through the liquid, stirring or shaking it up before taking each dose.

The proximate principle called vegetable albumen, which is soluble in cold water and alcohol, is coagulable at a boiling temperature, and hence is removed from decoctions on straining them.

The existence of starch and tannic acid together, in a vegetable substance, forbids the long-continued application of a boiling temperature, especially during exposure to the air, as a tannate of starch is formed which is insoluble, and comparatively inert. The state of division of the drug is among the most important points to be observed in preparing decoctions; if too coarse, it is liable to be imperfectly extracted, while, by being too finely divided, it is rendered difficult to separate on the strainer. In preparing decoctions of the vegetable astringents, the use of an iron or rusted tin vessel is to be avoided on account of the inky tannate of iron being formed.

In making decoctions the ebullition should not be violent or long continued, as simmering answers every purpose of hard boiling. If the drug contains an essential oil or other volatile principle, the vessel should be covered.

OFFICINAL DECOCTIONS.

Decocta, U. S.

Name.	Proportions.	Medical Properties.
Decoctum chimaphilæ	℥j to Oj	Alterative, diaphoretic.
" uvæ ursi	do.	Astringent, diuretic.
" dulcamaræ	do.	Sedative, alterative.
" hæmatoxyli	do.	Astringent.
" quercus alb.	do.	do. Externally.
" cinch. flav.	do.	Tonic.
" " rub.	do.	do.
" cornus floridæ	do.	do.
" senegæ	do.	Acrid expectorant.
" hordei	do.	Nutritive, diet.
" cetrariæ	℥ss to Oj	Tonic, demulcent.
" sarsaparilla comp. (*see* Formula)	℥iss to Oj	Alterative.
" aloes comp., *Br. P.* (*see* Formula)	gr. 120 to f℥xxx	Aperient, emmenagogue.

REMARKS ON THE DECOCTIONS.

The dose of the decoctions is the same as of the infusions, from f℥ij to Oj, or may be generally stated at one pint in divided portions. Care has been taken by the framers of the *Pharmacopœia* to select for this form of preparation those drugs least liable to deterioration by exposure to the influence of heat and the atmosphere. To this remark *the decoctions of cinchona* seem exceptions; these are even more objectionable than the hot infusions, letting fall a copious precipitate on cooling, which is apt to contain most of the alkaloids. They are improved by the addition of a little aromatic sulphuric acid, and should always be strained while hot, and shaken up when about to be administered.

Chimaphila and *uva ursi* are well adapted to this form of preparation, the coriaceous surface of the leaves having a tendency to resist the action of water at a lower temperature. The *decoction of senega* is almost superseded by the syrup, which is a far more agreeable preparation, and is efficient in a much smaller dose.

The formula for the preparation of these is so nearly uniform, that with the exceptions of decoctions of pearl barley, decoction of Iceland moss, and compound decoction of sarsaparilla, given separately, it may be thus stated:—

Take of (the bruised drug), a troyounce.
Water, a sufficient quantity.

Boil the (bruised drug) in a pint of water for fifteen minutes, strain, and add sufficient water, through the strainer, to make the decoction measure a pint.

Decoctum Cetrariæ, U. S. (*Decoction of Iceland Moss.*)

Take of Iceland moss, half a troyounce.
Water, a sufficient quantity.

Boil the Iceland moss in a pint of water for fifteen minutes, strain with compression, and add sufficient water, through the strainer, to make the decoction measure a pint.

Decoctum Sarsaparillæ Compositum, U. S. (*Compound Decoction of Sarsaparilla.*)

	Ph. Br.
Take of Sarsaparilla, sliced and bruised, six troyounces.	10 oz.
Bark of sassafras root, sliced,	1 oz.
Guaiacum wood, rasped,	1 oz.
Liquorice root, bruised, each, a troyounce.	1 oz.
Mezereon, sliced, one hundred and eighty grains.	240 grs.
Water, a sufficient quantity.	Ovj imp.

Macerate with four pints of water for twelve hours (one hour, *Ph. Br.*); then boil for a quarter of an hour (ten minutes, *Ph. Br.*), strain, and add sufficient water, through the strainer, to make the decoction measure four pints.

Compound decoction of sarsaparilla, which is an imitation of the celebrated *Lisbon diet drink*, is also officinal in some other *Pharmacopœias*, and is much more extensively used in foreign countries than with us. It is often used along with or after a mercurial course.

Decoctum Hordei, U. S. (*Decoction of Barley.*)

Take of Barley, two troyounces.
Water, a sufficient quantity.

Having washed away the extraneous matters which adhere to the barley, boil it with half a pint of water for a short time, and throw away the resulting liquid. Then, having poured on it four pints of boiling water, boil down to two pints, and strain.

Decoctum hordei, called barley-water, is peculiar in its mode of preparation, the directions requiring that the decorticated seeds, called pearl barley, as above, should be washed with cold water to separate extraneous matters, then boiled for a short time in a small portion of water, which is to be thrown away: upon the seeds, which, by this process, are completely freed from any unpleasant taste, and are much swollen, the remainder of the water is poured boiling hot; it is now to be boiled down to two pints and strained. These directions are peculiar to the *U. S. Pharmacopœia*, in the *Ph. Br.*, two ounces of pearl barley, after being washed in cold water, are boiled for twenty minutes in one and a half pints of water. Various adjuvants may be used to improve the taste of this, such as raisins, figs, or liquorice root, when not contraindicated. Its use is as a demulcent and nutritive drink in inflammatory and febrile diseases affecting the alimentary canal and the urinary organs.

CHAPTER VI.

PERCOLATION, OR THE DISPLACEMENT PROCESS.

A KNOWLEDGE of this process is justly regarded as indispensable to all who practise pharmacy. In previous editions of this work many details were rendered necessary by imperfect knowledge of the essential conditions of success in extracting the soluble principles of drugs, which are now no longer required. In accordance with the results of investigation and experience, the *U. S. Pharmacopœia* has given, in the late editions, such lucid directions for its employment in making the numerous tinctures, wines, vinegars, syrups, extracts, fluid extracts, and some of the infusions, that its adoption has become almost universal, and has effected a corresponding improvement in these classes of preparations.

History.—The process of percolation or displacement has been employed from time immemorial in the preparation of coffee in the celebrated *Cafetière de Doubelloy*, an instrument much used in France, and occasionally in this country at the present time. It consists of a coffee-pot, surmounted by a movable cylinder, usually varying from three to five or six inches in diameter, and from eight to ten inches in length, and which contains two perforated diaphragms, one permanent and soldered on to the lower extremity of the cylinder, and the other movable, so as to be supported either above or upon the top of the mass of coffee in using the apparatus.

The French coffee-pot is a displacement apparatus of convenient construction, and had been long celebrated for the production of a clear and strong coffee, possessing a finer aroma than that made by decoction, but, until the year 1833, the idea seems not to have occurred of applying it to the production of pharmaceutical preparations. This application is due to M. Boullay & Son, French pharmaciens, who, by their admirable and well-conducted experiments, first demonstrated the adaptation of percolation to the general purposes of the shop and laboratory, drew the attention of the profession to its merits, and pointed out certain forms of apparatus, and the modes for using them.

In 1836 an article by M. A. Guillermond, translated from the *Journal de Pharmacie*, was published in the *American Journal of Pharmacy*, vol. vii. p. 308, and in 1838 the late Augustine Duhamel, a scientific pharmacist of Philadelphia, published, in the *American Journal of Pharmacy*, vol. x. p. 1, his first communication upon the new process. In the following year, in connection with William Procter, Jr., now Professor of Pharmacy in the Philadelphia

College of Pharmacy, he engaged further attention to the subject in an able article of the same Journal, vol. xi. p. 189, in which a series of careful experiments in the preparation of extracts, tinctures, infusions, and syrups was detailed, which so conclusively proved the superiority of this over the ordinary processes in use that intelligent pharmacists generally were induced to try, and eventually to adopt it. In the mean time the process was extensively made known through pharmaceutical works in England and on the continent of Europe, and was incorporated more or less fully into the several *Pharmacopœias*.

This process so far found favor with the committee having under care the decennial revision of the *U. S. Pharmacopœia* in 1840, that it was sanctioned to a considerable extent in the edition of our national standard for that year. In 1850 it was still more fully adopted, though not without directions for maceration designed for those not practically familiar with it. At the present time, it is so fully recognized and extensively employed in the preparation of Galenical solutions, as almost to supersede the process of maceration.

At the annual meeting of the American Pharmaceutical Association in 1858, Prof. I. J. Grahame, of the Maryland College of Pharmacy, proposed some modifications of the process as then conducted, of so much utility as to have given a new impetus to this branch of pharmaceutical manipulation. His improvement consisted: *First*, in the use of the common funnel for all ordinary purposes, the conical shape allowing the swelling of the solid contents without compacting them so tightly together as in the case of a straight-sided cylinder. *Second*, the use of powders of regular and definite degrees of fineness, regulated by the permeability of the drug. *Third*, the proper graduation of the moisture imparted to the powder before packing it in the funnel. Increased attention to these points has simplified the process and increased its rapidity and efficiency.

The far more ready and universal adoption of percolation in the United States than in England has, perhaps, promoted the adoption, among us, of the more concentrated forms of medicines in preference to those prepared by the old processes, still largely employed by the British and some continental pharmacists.

Dr. E. R. Squibb has since done much toward improving the process. By frequently repeated experiments upon a great number of drugs of different degrees of fineness he has shown that much of the menstruum directed in the older formulas was often unnecessary, and sometimes injurious, as it required prolonged exposure to heat in finishing the preparations. The modifications of the process were such as to induce the introduction of a new term, that of repercolation. The whole of the papers can be consulted in the *Proceedings of the Am. Pharm. Assoc.* for the years 1865, 1866, 1867, and 1870. The process consists essentially of submitting the same menstruum to different and fresh portions of the drug to be exhausted. The usual method of procedure is this: the powder to be acted

upon is divided into three portions; the first is to be moistened with the desired quantity of menstruum, and, after standing half an hour in a covered vessel, is to be transferred to a percolating funnel; the first two or three fluidounces that pass are to be returned to the funnel, and five parts of menstruum are to be added part at a time, after each one has been absorbed; the percolation should continue till six and one half parts have passed, the percolate being divided into different portions, first of two parts, and the others of a part each, except the last which will be a half part. Proceed with the second portion of material in the same manner, using the first of one hundred parts of percolate in place of fresh menstruum, and following the last addition of percolate with fresh menstruum—this is to be continued as before until 7.5 parts are obtained. This process is to be repeated with the third portion of material, using the first two parts of menstruum from the second process, and it is to be continued until 9.5 parts of percolate have been obtained. The alcohol, when that is the menstruum employed, is to be recovered by distillation.

Mr. Samuel Campbell, of Philadelphia, has also written several papers of practical value upon this subject, in which he recommends maceration as being far more important than fine comminution. His papers are published in the *Am. Journ. Pharm.*, vol. 41, 42.

The common *tin displacer* consists of a cylinder varying in size, but at least twice as long as its diameter, terminated at one end by a funnel, the neck of which is made small enough to insert conveniently into a common tincture or narrow-mouth packing bottle; two perforated diaphragms of the size of the cylinder, and loosely fitting into it; each of these has a small ring of wire soldered on to it to facilitate its removal. Sometimes these cylinders are much larger at the top, tapering toward the lower end, and there is an advantage in this shape over straight sides, as shown in the drawing. The lower diaphragm should be of finely perforated tin plate (the finest sold is not objectionable), while the upper may be made of ordinary tinned iron, pierced with comparatively large holes. Occasionally the lower diaphragm is soldered to a very small tin tube, open at both ends, of nearly the length of the cylinder, near the top of which is a ledge on which the upper diaphragm is made to rest, as in the French coffee-pot and in the air-tight displacer (Fig. 222); the object of this is to allow the passage of air from the lower or receiving vessel into the top of the cylinder. A brass stopcock has been recommended to be added to

Fig. 216.

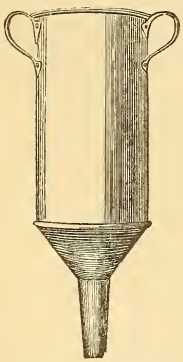
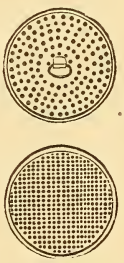


Fig. 217.



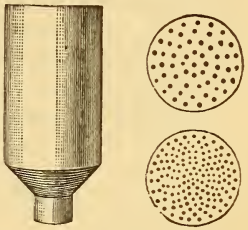
The displacer, with upper and lower diaphragm.

the lower orifice, so that maceration can be effected in the percolator.

The Queensware Displacer.—This is the same as the above in shape; the material is more cleanly; it is not liable to corrosion with acid liquids, nor to impart a black color and metallic taste to solutions of the vegetable astringents.

Lamp-chimney Displacers.—No form of apparatus is cheaper for small operations than ordinary lamp-chimneys, either plain (Fig. 220) or with bulb (Fig. 221). The smaller end of the chimney is filled with a cork cut so as to allow the free passage of the liquid, at the same time that it affords a mechanical support to the mass, or covered with a piece of gauze, book-muslin, or other coarse fabric, tied securely by a string round the chimney near its lower edge, and a little carded cotton being placed on it, the under diaphragm is rendered complete; the upper one may be made of paper, when necessary, as before described, or, where the diameter is small, may be omitted.

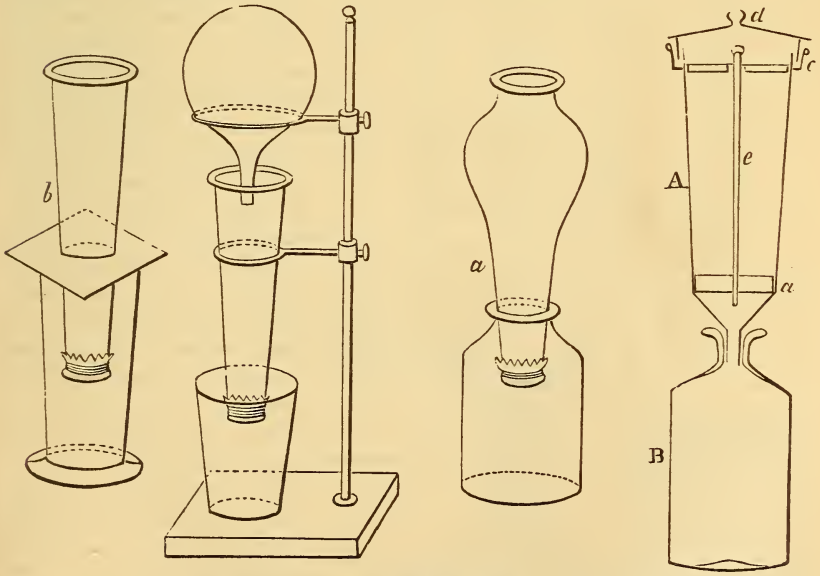
Fig. 218. Fig. 219.



Porcelain displacer, with two diaphragms.

These, having no funnel-shaped terminations, require to be inserted in a wide-mouth bottle; one which answers the purpose should be selected and always kept at hand; a piece of thick pasteboard, or other firm substance, may be used as a support for an apparatus of this descrip-

Fig. 220. Fig. 221. Fig. 222.



Lamp-chimney displacer, with supports.

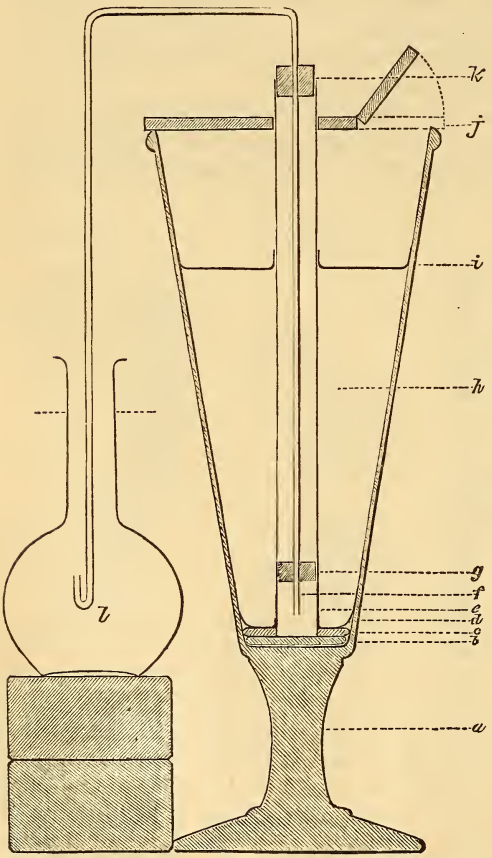
Tin displacer for volatile liquids.

tion by cutting a hole in it of the required size, so as to suspend it over a dish, or by the aid of a retort stand into a suitable jar or measure, as shown in Figs. 220 and 221. Lamp-chimneys with bulbs are still more convenient in this respect.

Fig. 222 represents a tin displacer with a water-joint near the top for covering and preventing evaporation in making ethereal or other very volatile preparations; the little tube *e* serves for the escape of the air from the lower vessel *B*, so as to equalize the atmospheric pressure between the top of the air-tight displacer and the receiving bottle; the lower diaphragm *a* is soldered on to the top of this tube, and the upper diaphragm rests on it; *c* represents the gutter into which the top *d* fits, and which, being filled with water, constitutes an air-tight connection. The displacer fits into the narrow-mouth bottle either by the aid of a cork or not, as the case may require.

The form of percolator devised by Dr. E. R. Squibb is, perhaps, the most complete for the purpose of the pharmacist of any yet described; it is represented in Fig. 223.

Fig. 223.



h, percolator, 11½ in. deep inside measure; 5½ in. diameter at top; 2 in. diameter at bottom, which should be flat; a rim around the top serves to strengthen it; the upper edge should be ground flat so that it may be covered perfectly. The cover is best made of heavy sheet India-rubber; a section about one-third being cut nearly through from the lower side forms a good hinge. *e* is the well-tube; *f*, *l*, siphon, which is automatic and empties the well-tube. For a full description of the method of manipulating, the reader should consult the paper in *Proc. Amer. Pharm. Ass.*, vol. xx. p. 182.

Broken Bottles.—A portion of the broken bottles in a shop have the bottom cracked uniformly off, which is likely to occur

when hot liquids are poured into them; they furnish a cylinder-shaped vessel not unlike the tin displacement apparatus above described (Fig. 222); a plug of cotton is used for a diaphragm, as in the case of the funnel. The bottoms of bottles may be cracked off for this purpose by passing gradually round them a red-hot rod of iron in contact with the glass, and, when fractured, removing the sharp edge by a file, or by inserting the bottle in a shallow vessel of cold water, so as to be immersed just up to the line to be fractured, and filling it nearly to the same line with water, then pouring in a sufficient quantity of oil of vitriol suddenly to raise the temperature on the inside, the bottom will generally drop out.

Very convenient and economical glass displacement funnels are made of various sizes, in shape like a broken bottle, but thicker and more uniform, and with a smooth edge at both ends; the neck is drawn out with the view to inserting into a bottle, and the cylinder may be conveniently covered with a suitable piece of glass when desirable. No diaphragms accompany the apparatus; sponge, cotton, or broken glass being used.

Fig. 224.

Small syringe pattern displacer.

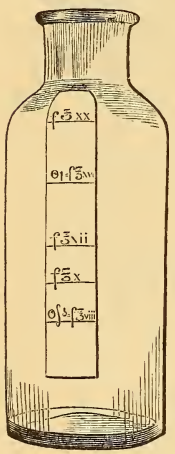
Availing ourselves of the very cheap and common production of syringes from glass tubes, which extend to one and a quarter inch in diameter, and can be furnished at a very low price, we have procured the apparatus represented in Fig. 224. It is a glass syringe of the largest size, without the piston or cap. It can only be used for small operations, for which, however, it is well adapted. In treating Spanish flies and other substances with ether, we have found it convenient from the facility with which the top can be corked up, preventing evaporation; a variety of preparations may be conveniently made with the syringe pattern displacer.

The Glass Funnel.—As already stated, the common funnel furnishes one of the most complete forms of displacement apparatus. A porous diaphragm inserted at the upper and widest portion of the neck, may consist of a piece of moistened sponge, of cotton, or of tow, but a perforated cork covered with a disk of filtering paper is preferable, while for the purpose of spreading the liquid over the surface of the mass, a circular piece of porous paper or of cotton cloth will serve every purpose. When a straight cylinder is used the swelling of the solid contents of the displacer during the progress of its saturation with the menstruum frequently almost arrests the passage of the liquid; but in an ordinary funnel the lateral pressure is forced into an upward direction, owing to the tapering of the sides of the funnel, and while the mass is rendered sufficiently compact, it is not so compressed as to interfere with the operation of capillary attraction and the displacement resulting from the pressure of the superincumbent liquid.

In the *Pharmacopœia*, the form of the percolator is often, though not always, designated in the several formulas. When ether is used as a menstruum, cylindrical percolators are directed to be used. When a funnel is used, a circular piece of muslin or of lint is directed to be pressed into the neck by means of a cork with notched sides, but in all cases a similar piece of muslin, moistened slightly with the menstruum, is directed to be interposed between the diaphragm and the powder to prevent the passage of the fine particles of the latter.

Receiving Vessel.—For reasons that will more fully appear when describing the management of the process, it is necessary that the receiving vessel should be of such size as to hold precisely the quantity it is proposed to make, or be suitably graduated to this quantity. A convenient plan adopted in the school of practical pharmacy, where various preparations are going on at the same time, is to mark upon a narrow slip of paper the name and quantity of the preparation about being made, and paste this upon the receiving vessel before commencing the process, in such a position that when the required quantity has passed it will just reach the top of the slip of paper.

Fig. 225.



Graduated receiving bottle.

It is convenient for common purposes to keep one or more graduated bottles, made by pasting a slip of paper longitudinally on the bottles marked with a pen to the f℥viij, f℥x, f℥xij, Oj, and f℥xx denominations, as shown in this cut; the paper may be rendered impervious to moisture by collodion or other varnish.

The Management of the Process.—The following general directions describe the most approved mode of conducting percolation:—

Reduce the substance to a uniform powder which will pass through a sieve of from twenty to fifty meshes to the linear inch (if of very close texture a sieve of sixty meshes is to be preferred); now add just sufficient of the menstruum to dampen the powder without wholly destroying its mobility; this usually requires from one-fourth to one-half as much menstruum as powder, and may be accomplished on paper without moistening it. Now transfer to a glass funnel or other cylindrical vessel with a porous diaphragm, and pack it with little or much pressure, according to its tenacity or disposition to adhere (more firmly when alcohol or ether is the menstruum than when water is to be used); if the particles of the moistened powder move freely on each other, the packing should be with as much force as a glass vessel will bear, the whole of the powder being introduced at once, and packed with a pestle or packing-stick. The percolator being now properly supported with its neck in a marked receiving vessel, the whole quantity of the men-

struum may be poured on, or to the capacity of the funnel, and the process allowed to proceed to completion. The liquid must not be allowed to pass more rapidly than by drops, and where a continuous stream runs from the extremity it is an indication of the necessity of more thorough packing. In most cases this may be remedied by corking up the tubule of the funnel and allowing the mass to become more compact by swelling, or it may be necessary to remove and repack the mass.

Instances in which ether or strong alcohol is used as the menstruum, frequently constitute exceptions to the rule of passing by drops; in these the operator will use his judgment as to repassing the liquid, being careful that the strength is fully and completely extracted by the quantity of liquid remaining in the preparation when completed.

In the process of packing the moistened powder into the cylinder, reference must be had to the nature of the substance in hand and the menstruum; the rule seems to be that the firmness of the packing should be inversely as the solvent and softening power of the liquid upon the solid under treatment.

When a substance in a suitable powder has been dampened and properly packed in a percolator, so that, on the addition of the liquid above, it passes drop by drop, and the first portions, being returned, give a clear and very strong preparation, *the last portions of liquid should pass almost destitute of the soluble principles* contained in the drug. This is the clearest indication of the success of the manipulation, and obviates the necessity of any means of *expressing* the last portions of liquid from a porous mass.

In making preparations by displacement, we should aim by skilful manipulation to extract nearly all from the drug that is soluble, before reaching the measure indicated in the formula, the last addition will then serve to displace the last portion held by the dregs, and to dilute the liquid to the proper point.

After the process of maceration the dregs are almost always saturated with the strongest portion of the liquid, which is wasted unless some means of expression are resorted to; but, if the dregs be thrown upon a filter and drained, and a portion of the menstruum poured upon it, the last drop may sometimes be displaced without a resort to the troublesome process of expression.

If the liquid thus added to the dregs is different from the menstruum originally employed, and especially if it is a heavier liquid, it is liable to mix with it, and sometimes results in injury to the preparation. By adding about one-third less of the displacing liquid than the supposed quantity of menstruum remaining in the dregs, this inconvenience is generally obviated.

In the preparation of tinctures in which the last portions cannot be recovered by adding water on to the top of the cylinder, and in making large quantities of extracts with strong alcohol, the considerable loss of the alcohol calls for the use of a press. Convenient screw-presses are made in the cities, and sold at moderate prices;

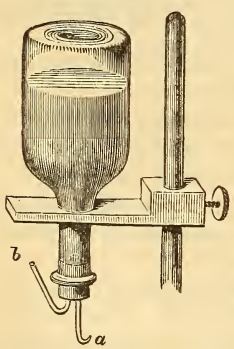
those shown in the previous chapter are well adapted to the object in view.

Solution of Gum Resins, etc., in Displacement Apparatus.—Vegetable products of this class are usually so soluble in the menstrua employed for their extraction as to render it a matter of little importance whether they are treated by maceration or percolation. They should be thoroughly divided in order to expose an extended surface to the action of the liquid, and, if dissolved by percolation, should be mixed with an equal bulk of sand to facilitate the process. Tinctures of this class made by maceration require to be filtered to free them from impurities suspended in them, the necessity of which is obviated when they are made by percolation.

Continuous percolation may be accomplished by the following automatic arrangement, which is adapted equally to filtration:—

A bottle or globe, capable of containing the quantity of menstruum necessary to complete the preparation, is fitted with a perforated cork, in which is inserted a glass tube of such length as that, being inverted over the percolator, the tube will descend below the surface of the liquid contained in it. The lower end of the tube should have a short curve turned on it; the bottle or globe being filled and arranged in this manner will not discharge any of its contents into the percolator until the surface of the liquid contained in it falls below the extremity of the tube; a bubble of air will then pass up into the bottle, and a corresponding portion of the liquid will descend. In this way, the supply in the percolator will be kept up until the bottle has emptied itself; and, if the quantity of the liquid has been accurately estimated, the preparation will be finished without further attention.

Fig. 226.



Bottle for continuous filtration and displacement.

Instead of having merely a straight piece of tube inserted in the mouth of the bottle from which the liquid is supplied, two tubes may be used, as shown in Fig. 226. In this case, the afflux tube *a* is turned up at the end, as recommended above, and as the liquid runs out here air enters at *b*. The surface of the liquid into which *a* is immersed must, however, be so far below the lowest point of *b* as to enable the air to depress the liquid in the external ascending part of *b*, and thus to enter the bottle.

The size of the tubes must be also so arranged that the liquid will not run from *a* unless the orifice of the tube be in contact with the contents of the filter, so that the cohesive attraction of the liquid may overcome the capillary attraction.

The *rationale* of the process of percolation is very similar to that of filtration; both are due to capillary attraction. In ordinary filtration, the capillarity of the paper causes the absorption of a certain quantity of liquid, but on more than enough to wet it being

added, the pressure of this drives out the first, taking its place, and so on. Precisely the same thing occurs in percolation; a porous substance, being saturated with any liquid for which it has an affinity, will yield this up, if a portion of liquid be poured on above, from the force of gravitation merely; and hence, in proportion to the height of the column of liquid, other things being equal, will be the rapidity of the process.

The fact that alcohol and ether pass through most plants so much more rapidly than water, is due, perhaps, in part to these liquids being less forcibly held by this species of attraction, but mainly to their dissolving less freely the organic proximate principles most abounding in plants, and which render aqueous liquids so thick and viscid as to pass with difficulty.

Very porous drugs, such as rhubarb, senna, squill, gentian, hyoscyamus, and others containing a large proportion of extractive matters, cannot be conveniently treated by displacement with wine or liquids containing a considerable proportion of water, owing to their powerful capillarity; in treating these, either by water, diluted alcohol, or diluted acetic acid, the following points are to be observed:—

a. The powder must not be too fine, though uniform. The *Pharmacopœia* directs for rhubarb, to be treated with mixed alcohol and diluted alcohol, in a powder which would pass through a sieve of 50 meshes to the linear inch (moderately fine); or in instances where diluted alcohol is used, 40 meshes (moderately coarse). For senna, treated with diluted alcohol, moderately fine. Squill, treated either with diluted alcohol or diluted acetic acid, moderately coarse. Gentian is ordered in moderately fine (No. 50) and moderately coarse (No. 40) powder, according to the alcoholic strength of the menstruum.

b. The coarse powder must be thoroughly moistened with the menstruum before being introduced into the precolator; it must be at first rather loosely packed, otherwise, being swelled very much on the absorption of the liquid, it may become too tight. The common funnel is to be preferred under these circumstances.

c. When the process proceeds with difficulty, from the causes above described, or from otherwise defective manipulation, it may be partly obviated by adding a considerable column of the menstruum above the mass; this, acting by hydrostatic pressure, forces the liquid through with increased facility.

d. Time and patience will, to a certain extent, correct the same difficulty; after the first portions of the liquid, which pass so slowly from being highly charged with the soluble principles, and from the continued swelling of the powder, the remainder will often come through more readily, increasing in rapidity to the end.

e. The admixture of sand serves a good purpose in this case, as in that of the gum resins.

f. Alcohol, diluted in various proportions with water, is directed for making fluid extract of senna, fluid extract of pink-root, syrup of rhubarb, syrup of seneka, compound syrup of squill, and some

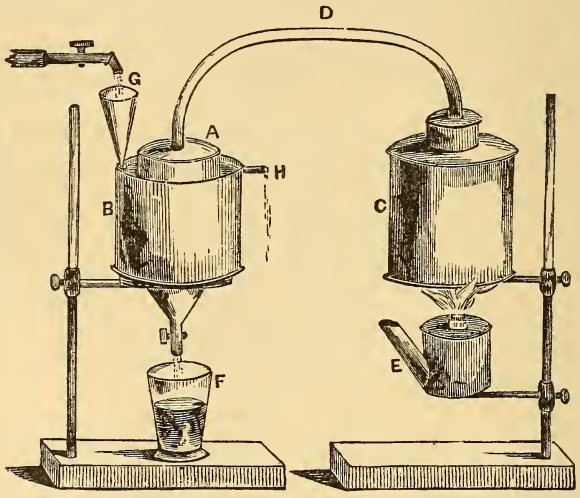
other preparations, on account of the difficulty of conducting the percolation with water alone.

Very compact Drugs.—Seeds and other parts of plants, when of close texture, not readily penetrable by menstrua, may require, as directed in the case of tincture of nux vomica, that the finely powdered drug be subjected to prolonged elevation of temperature in contact with the menstruum, previously to percolation. And the instances are frequent, not only in preparing fluid extracts, but also tinctures, that owing to failure to extract the whole strength of the drug with the quantity of menstruum ordered, it becomes necessary to continue the process and evaporate the excess of the menstruum; in such cases, special care must be taken to preserve the proper alcoholic strength of the preparation by allowing for the greater proportional loss of the more volatile ingredient, and to prevent the deterioration of the preparation by heat, by the precaution almost invariably directed in the *Pharmacopœia*, of setting aside the first, more concentrated, part, evaporating the last portion only, and finally mixing the liquors.

Displacement, applied to hot liquids, requires some modification of the apparatus and the manipulation.

The deterioration to which vegetable infusions are liable by boiling is adverted to under that head; the chief use of percolation with steam or hot liquids is to obviate this, at the same time that the advantages of high temperature are secured.

Fig. 227.



Smith's steam displacer.

The steam percolator, Fig. 227, invented by the late C. Augustus Smith, of Cincinnati, Ohio, consists of two distinct parts, *B*, the displacer, and *C*, the boiler, connected by a tube of tin or lead, *D*. *A* is a tin cap luted on to the top of a common displacement tube terminating in the funnel-shaped appendage below. This is sur-

rounded by a tin jacket, into the bottom of which the conical tube *G* conducts cold water, while the spout *H* discharges the warmed water from the top. The substance to be treated being placed in the displacer, and the liquid designed to be applied to it put into the boiler, the connections are luted on, and heat applied by the lamp *E*, or preferably by a gas furnace. The vapor which is generated passes through the tube *D*, and penetrates the whole mass in the displacer; the jacket being now filled with cold water, the steam is condensed and passes out below, where it is collected in the receiver *F*. The advantage is thus gained of penetrating the powder thoroughly by the aid of heat, while the deteriorating influence of decoction is avoided.

This instrument possesses advantages over the ordinary means for extraction with hot liquids which should recommend it to general favor; it is not only useful as a substitute for decoction, but obviates the difficulty above adverted to of extracting certain porous and largely soluble vegetables with water. The steam, whether of water or alcohol, being generated in the boiler and passed into the displacer before the addition of cold water to the cooler, is maintained at an elevated temperature until it has thoroughly permeated the mass; it is then, by refrigeration, converted into liquid, which finds ready egress through the lower orifice, and is highly charged with the soluble vegetable principles present. The removal of these, added to the pressure of the steam, continually kept up from the boiler as fast as it is condensed, renders the flow rapid and the preparation concentrated.

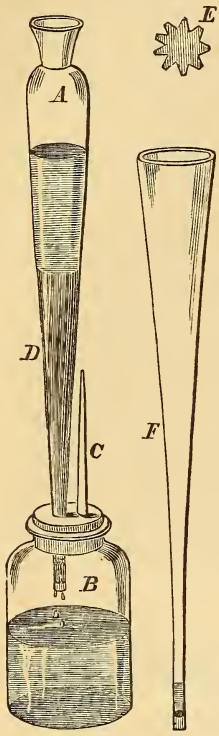
Fluid extract of senna can be prepared in the steam displacer without the use of alcohol as a menstruum; so concentrated is the decoction obtained in the first instance as to require very little evaporation to bring it to the officinal standard.

The apparatus, as above described, is imperfectly adapted to treating substances with diluted alcohol; if that liquid be placed in the boiler, the effect of the heat applied is to drive over the alcohol first and then the water, so that the first portion being stronger of the resinous principles, and the latter of the starch and extractive, the mixture of the two would be turbid. To obviate this, two boilers are sometimes adapted to one cylinder, one for alcohol and the other for water, and, by a proper regulation of the heat to each, the vapors may be brought over in nearly equal proportions at the same time. The cylinder should not be made of too great diameter nor length; but I am informed by the inventor that he uses cylinders of the capacity of a barrel; this is perhaps the largest size that would answer well in practice; where larger quantities of the same substance are to be treated at once than will fill such a cylinder, or where several different operations requiring the same menstruum are to be conducted simultaneously, two or more cylinders may be attached to the same boiler, and placed in the same cooler.

Substances heretofore digested in hot alcohol, a very inconvenient process, may be treated with that menstruum with great facility by using this apparatus.

For *percolation with ether*, an ingenious apparatus, invented by Prof. Mohr, is figured in his work. It combines the advantages of a good air-tight displacer with that of a still for recovering the ether; it is, however, a complex apparatus, and rather troublesome to use.

Fig. 228.



Extemporaneous glass displacers.

For percolation at ordinary temperatures, especially where a small amount of the medicinal substance is to be treated with ether, a common displacer may be used, care being taken to cover it and the receiving vessel, to prevent evaporation; a narrow lamp-chimney, fitting below into a wide-mouth bottle, will be found to serve a good purpose, or, if large enough, a syringe pattern displacer. An adapter, such as is used in retort operations (Fig. 228 *A*), may be inserted through a perforated cork into a convenient bottle, the top being covered with a piece of bladder pierced with pin holes, or fitted rather loosely with a cork to prevent evaporation.

Fig. 228 represents two forms of displacers for ether and other volatile liquids; *A* is an adapter. The tube *C* is drawn out into a fine point, so as to admit the passage of the air without favoring evaporation. *E* represents a notched cork diaphragm, *F* a broken retort beak, suited to similar operations.

The application of a vacuum to promote the rapidity of percolation is an important improvement in certain cases, and several very ingenious forms of apparatus have been contrived by the French with this end in view; perhaps the best of these are the coffee-pots, in which the pressure of steam is first brought to bear in penetrating the mass with the hot liquid, and then, by the withdrawal of the source of heat, the steam is immediately condensed, creating a vacuum which hastens the downward passage of the liquid. In using Smith's steam displacer, though at no time a very complete vacuum is formed, yet this principle comes into play, and undoubtedly facilitates the percolation of the mass under treatment, in the same way that it operates in a vacuum displacer.

CHAPTER VII.

TINCTURES.

The consideration of the process of percolation has prepared the student to enter upon those Galenical solutions in the preparation of which it is employed. Prominent among these, as the most numerous and most varied, is the class of tinctures called by the French alcoolatures.

The study of these and other Galenical solutions is less attended to by students than their importance demands; in some respects, a knowledge of pharmaceutical preparations is more important than a familiarity with the drugs themselves. It is the preparations that enter into the prescriptions of the physician almost exclusively; he should be acquainted not only with their doses, but with their proper therapeutical and pharmaceutical adaptations, as modified by the menstrua employed in their preparation, by their degree of concentration, their miscibility with other liquids, and their other physical peculiarities.

With a view to conveying this knowledge, as far as practicable, the present chapter is devoted to the consideration of the tinctures officinal in the *U. S. Pharmacopœia*, and those unofficinal tinctures which are commonly used in this country.

Tinctures invariably contain alcohol, generally more or less diluted, as the vehicle for their active ingredients.

Alcohol, as officinal in the *Pharmacopœia*, is a colorless, limpid, very volatile liquid, of a peculiar penetrating odor, and burning taste, having a specific gravity of .835. Its chief impurities, as found in commerce, are as follows: Water, which increases its specific gravity in the ratio of its proportion; fusel oil, a constituent of whiskey, which, being volatile, though less so than alcohol, is generally imperfectly separated in the distillation; this may be detected, by its imparting the peculiar odor of whiskey to the alcohol, and particularly by the odor left on the hand, after the alcohol has evaporated from it: and occasionally coloring matter, derived from the casks in which it is kept.

For a description of the mode of manufacture and chemical characters of alcohol the reader is referred to Part IV., where it is treated of as a product of Fermentation.

Alcohol, of .835 sp. gr., called druggist's alcohol, contains 85 per cent. of pure or absolute alcohol; it is an excellent solvent for a large number of vegetable substances, as resins, camphor, benzoic acid, tannic acid, the balsams, grape sugar, the vegetable alkalies, castor oil, also for some inorganic substances, as iodine, chloride of iron,

carbonate and muriate of ammonia, caustic potassa and soda, nearly all deliquescent, and a few other salts. It mixes freely in all proportions with water, ether, acetic acid, and most of the essential oils, and reacts with several acids, forming ethers.

Besides its extensive solvent powers, qualifying it for so many uses in pharmacy, it is a most convenient antiseptic, effectually preventing fermentation in organic solutions to which it is added.

By the low temperature at which it evaporates, it is well suited to the preparation of concentrated medicines requiring evaporation.

In connection with these valuable physical properties, it has important therapeutical relations. Alcohol is a powerful arterial stimulant; even in small quantities it produces fulness of pulse, and a general excitant influence on the system; and hence the tinctures, especially those given in large doses, should not be used in the treatment of inflammatory diseases, and should be employed with prudence in all chronic cases, lest the continual stimulus derived from the alcohol they contain should lead to the habitual use of intoxicating drinks.

The use of strong alcohol in the preparation of tinctures is confined to a comparatively small number, chiefly such as contain a considerable proportion of essential oil, of resin, or of resinoid principles. These constitute the second class in the syllabi which follow.

Diluted Alcohol—Alcohol Dilutum, U. S. P.—This is more extensively employed than the foregoing as a menstruum for tinctures; is consists of equal parts by measure of alcohol and water; its specific gravity is .941. Containing water, the great natural solvent, in so large proportion, this liquid is capable of extracting from plants, gum, extractive matter, vegetable albumen, and most coloring matters which are soluble in that menstruum, and, to a certain extent, resinous matters, essential oils, and vegetable alkalies, soluble in alcohol; also sugar and tannic acid, soluble in both.

It has been supposed that the affinity for each other of the two ingredients in this liquid, interferes somewhat with the solvent powers of each; so that substances wholly insoluble in water would not be so thoroughly extracted by a given quantity of diluted alcohol, as by half the quantity of strong alcohol; and so in the case of substances insoluble in alcohol, they would not be so thoroughly extracted by the mixture as by water alone; but, according to the experiments of M. Jacques Personne, published in the *American Journal of Pharmacy*, vol. xviii. pp. 21, 103, the reverse of this is the fact, and a mixture of alcohol and water is stated to be a better solvent of the resinous and extractive principles of plants, than the same quantity of these two liquids separately employed.

Whatever may be the truth in theory, diluted alcohol is found in practice to answer a good purpose; furnishing tinctures which are reasonably permanent, at the same time that they are less stimulating than those made with strong alcohol, and are generally miscible with aqueous solutions without any portion of their active principles precipitating.

Several observers have, however, directed attention to the deposits universally occurring in tinctures after long standing, and the conclusion has been reached, by experiment, that these generally contain appreciable quantities of the active ingredients of the preparations.

There are, no doubt, advantages gained by varying the proportions of water and alcohol to suit particular drugs.

There are several preparations officinal in the *Pharmacopœia* which are exceptions in the proportion of alcohol contained in them. The infusion of digitalis, and compound infusion of gentian, as before stated, are rendered permanent by small quantities of alcohol added to them, or by being made with very weak diluted alcohol.

The numerous fluid extracts are made with varied proportions of alcohol, glycerin, and water in extracting the drugs, and also with a suitable proportion of alcohol and glycerin added for its antiseptic properties.

In the last edition of the *U. S. Pharmacopœia*, a change which was commenced in the preceding edition has been more fully carried out, much to the gratification of many pharmacists who felt the controlling authority of the *Pharmacopœia*, and yet were well assured that menstrua of different alcoholic strengths were required to properly extract the active principles of the various drugs directed in the formulas.

The following syllabus will enable the student to fix the various tinctures in their relation to the menstrua most readily in his mind.

SYLLABUS OF TINCTURES (U. S. P. 1870) SHOWING THE ALCOHOLIC STRENGTH OF MENSTRUUM AND PROPORTION OF DRUG TO A PINT.

Name of Tincture.	Strength of menstruum.	Proportion of drug.
Aconiti radicis	Alcohol	℥vj to Oj.
Aloes et myrrhæ	"	℥iij of each to Oj.
Assafœtidæ	"	℥ij to Oj.
Benzoini	"	℥iij to Oj.
" comp.	"	℥iij benz., ℥ss soc. aloes, ℥ij storax, ℥j tolu — alco. Oij.
Cannabis	"	grs. 360 ext. to Oj.
Castorei	"	℥j to Oj.
Guaiaci	"	℥iij to Oj.
Iodini	"	℥j to Oj.
" comp.	"	℥ss iodine, ℥j iodide potassium.
Lupulinæ	"	℥ij to Oj.
Myrrhæ	"	℥iss to Oj.
Nucis vomicæ	"	℥iv to Oj.
Tolutana	"	℥iss to Oj.
Veratri viridis	"	℥viij to Oj.
Zinziber	"	℥iv to Oj.
Arnica	Alcohol 3 parts, water 1 part	℥iij to Oj.
Cinchonæ	" " " "	℥iij to Oj. [taria.
" comp.	" " " "	℥iv cinchona, grs. 360 serpen- ℥iij b. orange peel, Oiiss alco. ¾.

SYLLABUS OF TINCTURES—*Continued.*

Name of tincture.	Strength of menstruum.	Proportion of drug.
Ferri chloridi	Alcohol 3 parts, sol. iron 1 part	
Sanguinaria	Alcohol 3 parts, water 1 part	℥ij to Oj.
Cinnamon	Alcohol 2 parts, water 1 part	℥iss to Oj.
Jalapæ	" " " "	℥iij to Oj.
Kino	" " " "	grs. 720 to Oj.
Aurantii	Alcohol 1 part, water 1 part	℥ij to Oj.
Belladonnæ	" " " "	℥ij to Oj.
Colchicum	" " " "	℥ij to Oj.
Colombo	" " " "	℥ij to Oj.
Cantharides	" " " "	℥ss to Oj.
Capsici	" " " "	℥ss to Oj.
Cardamomi	" " " "	℥ij to Oj.
" comp.	" " " "	grs. 360 cardamom, grs. 120 caraway, grs. 300 cinnamon, grs. 60 cochineal } ℥ij honey to Oi
Catechu	" " " "	℥ij cinnamon, ℥iij catechu } to Oij.
Conii	" " " "	℥ij to Oj.
Cubeba	" " " "	℥ij to Oj.
Digitalis	" " " "	℥ij to Oj.
Gallæ	" " " "	℥ij to Oj.
Gentian. comp.	" " " "	℥ij gentian, ℥j bitter orange peel, ℥ss cardamom } to Oij.
Hellebori	" " " "	℥ij to Oj.
Humuli	" " " "	℥iiss to Oj.
Hyosciami	" " " "	℥ij to Oj.
Krameria	" " " "	℥iij to Oj.
Lobelia	" " " "	℥ij to Oj.
Opii	" " " "	℥i¼ to Oj.
Opii camphorata	" " " "	grs. 60 opium, grs. 60 benzoic acid, grs. 40 camphor, ℥j oil anise, ℥ij honey } to Oij.
Quassia	" " " "	℥j to Oij.
Rhei et gennæ	" " " "	
Scillæ	" " " "	℥ij to Oj.
Serpentariæ	" " " "	℥ij to Oj.
Stramonii	" " " "	℥ij to Oj.
Aloes	Alcohol 1 part, water 3 parts	℥i¼ to Oj.
Opii deod.	" " " "	℥i¼ to Oj.
" acetata	Alcohol ½ part, dis. vinegar 12 oz.	℥ij opium.
Guaiaci ammon.	Spirits ammon. aromat.	℥iij to Oj.
Valerianæ ammon.	" " "	℥ij to Oj.

The formulas are given in this chapter for all the tinctures in the *U. S. Pharmacopœia*, and some others, deemed of importance. The following syllabi have been prepared by way of presenting in a single view this important class of preparations, and the classification gives facilities to the student for committing to memory the proportions, uses, and doses of the officinal tinctures.

THE OFFICINAL TINCTURES.

Classified for Study (See *Formulas and Comments.*)

Tincturæ, U. S. P. 1860.

Group 1.—Narcotics,* sedatives, etc. With diluted alcohol. Proportions, ℥ij of the drug to Oj. Doses, 10 drops to f℥ij.

Officinal name.	Med. properties.	Dose.	Remarks.
Tinctura belladonnæ	Narcotic	20 to 30 drops	From the leaves.
" stramonii	do.	do.	Made from the seeds.
" conii	Alterative, narcotic	30 to 60 drops	Misnamed tinct. cicutæ
" hyoscyami	Narcotic, laxative	do.	From the leaves.
" digitalis	Diuretic, sedative	10 drops	From English leaves of second year.
" scillæ	Emetic, diuretic, etc.	10 to 30 drops	*See* Acetum scillæ.
" colchici	Diuretic, etc.	20 drops to f℥j	From the seeds. *See* Vina and Aceta
" lobeliæ	Emetic, narcotic	f℥ss to f℥j	Emetic dose, f℥ss
" sanguinariæ	Alcohol 3 pts., water 1 pt., menstruum	do.	do.

The first group of tinctures are all made, with one exception, in the proportion of two ounces of the drug to one pint of diluted alcohol; they are easy of preparation by percolation, the herbs usually yielding their active principles and coloring matter before the whole amount of menstruum has passed. Stramonium and Colchicum tinctures are made of the powdered seeds: the former is remarkable for having a peculiar green or fluorescent appearance when seen by reflected light, though very clear and of a decided brown color by transmitted light.

The majority of them are narcotics, and are given in the dose of from 20 to 60 drops. Considered therapeutically the six first named in the table form a very natural group; the remaining four have fewer points of resemblance, and several cannot be classed with narcotics without doing some violence to their true position. The tincture of digitalis is not only peculiar in its therapeutical action, but forms an exception in the dose, which should not exceed ten drops.

Group 2.—Narcotics, sedatives, etc. With strong alcohol, saturated or nearly so. Doses, 5 to 10 drops.

Officinal name.	Proportions.	Dose.	Medical properties.
Tinctura aconiti radicis	℥vj to Oj	gtt. v to x	Nervous sedative.
" nucis vomicæ	℥iv to Oj	gtt. v to xv	Nervous stimulant.
" veratri viridis	℥viij to Oj	gtt. v to xv	Arterial sedative.
" cannabis	℥vj ext. to Oj	gtt. v to xx	Cerebral stimulant.

Tinctures of the second group are among the most powerful liquid preparations in use. They require the utmost care in percolating

* See Group 2, and Galenical Preparations of Opium.

the several drugs, that the process shall proceed so slowly and so completely as to extract the active principles from the large amounts prescribed, or should it happen that the whole strength has not been extracted up to the time or near the time of the full quantity having passed, it is better to set aside the tincture which has been collected and pass the remainder into an evaporating dish, in which it may be concentrated at a very low temperature and added to the first portion.

These tinctures should be generally diluted in prescription, rather than prescribed singly, except where the patient or nurse has experience and care in dropping.* It is needless to remind the reader that these tinctures are powerful *poisons*, though the tincture of veratrum viride is perhaps not unfrequently taken in doses much larger than that indicated above.

GROUP 3.—Chiefly stimulants and aromatics. Doses, generally from fʒj to fʒij. Made of varying proportions with diluted alcohol.

Officinal name.	Proportions.	Dose.	Med. properties, etc.
Tinctura valerianæ	℥ij to Oj	fʒij	Tonic, antispasm.
" serpentariæ	℥ij do.	do.	Stimulant, tonic.
" cubebæ	℥ij do.	do.	do. diuretic.
" cantharidis	℥ss do.	gtt. xx	do. to be diluted.
" capsici	℥ss do.	fʒj	do. do.
" cinnamomi	℥iss do.	fʒij	Aromat. adjuvant.
" cardamomi	℥j do.	fʒj	do. do.
" cardamomi comp.	to Oj { cardamom grs. 144, cinnamon grs. 120, caraway grs. 48, honey fʒvj, cochineal grs. 24 }	fʒss	do. do.
" arnicæ	ʒiij to Oj { alcohol 3 p., water 1 p. }		Used externally.

The third group has less points of resemblance among its members than either of the others. *Tinctures of valerian and serpentaria* may be substituted by the corresponding fluid extracts. *Tincture of cubebs* is rarely used, the oleoresin being adapted to the form of lozenge and of mixture. *Tincture of cantharides*, which is much prescribed as an addition to preparations for the hair, to the growth of which it is an admirable stimulant, should for this purpose be made with strong alcohol. *Tincture of arnica*, which is a new officinal, is often made with strong alcohol, which has the advantage, in view of its use externally, of less color, and more powerful stimulating properties. The addition of one-third water, as directed in the *Pharmacopœia*, should, of course, be complied with, out of respect to the national standard, and for the sake of uniformity. Three tinctures of this group are all used for the same purposes, as adjuvants to other medicines, in extemporaneous solutions and

* *The tincture of cannabis*, which is prepared by trituration in a mortar, is quite incompatible with aqueous liquids unless suspended, as directed under the head of Extemporaneous Preparations. It is very variable in strength, owing to the difference in the quality of the extract in commerce.

mixtures. The *compound* tincture of *cardamom* is a very elegant one for this purpose. In the late edition of the *Pharmacopœia* this has been improved by the substitution, for raisins, which were formerly introduced as a sweetening ingredient, of honey, which, besides being added with more facility, does not interfere with the permanence of the rich color, which is one of the great recommendations of this adjuvant.

Group 4.—These are made with diluted alcohol, excepting the simple and compound Tinctures of Cinchona. They are generally quite incompatible with salts of iron, forming inky solutions. They are all *astringents* or *tonics*, or both. Doses, from f ʒj to f ʒij.

Officinal Name.	Proportions.	Dose.	Med. Properties.
Tinctura gallæ	ʒij to Oj	f ʒij	Astringent.
" catechu	ʒiss to Oj with ʒj cinnam.	do.	do.
" kino	ʒiss to Oj { alcohol 2 p. / water 1 p.	f ʒj	do.
" krameriæ	ʒiij to Oj	do.	do.
" cinchonæ	do. (yellow bark) { alcohol 3 p. / water 1 p.	f ʒij	Tonic.
" " comp.	{ red bark ʒij / B. orange-peel ʒiss / serpentaria ʒiij } to f ʒxx { alcohol 3 p. / water 1 p.	do.	do. aromatic. (Huxham's.)
" calumbæ	ʒij to Oj	do.	Tonic.
" gentianæ comp.	{ gentian ʒj / B. orange-peel ʒss / cardamom ʒij } to Oj	do.	do. aromatic.
" quassiæ	ʒj to Oj	do.	do.
" humuli	ʒiiss to Oj	do.	do. sedative.

In this group the tonic and astringent preparations are appropriately associated, though differing among themselves. The *tinctures of quassia and colombo* are *sui generis* in containing no astringent principle. The dose of these will be observed to be larger than of the previous groups, ranging from two fluidrachms to half a fluidounce.

Tinctures of kino and catechu are very popular astringents, but liable to gelatinize by age, particularly the first named, on which account the *Pharmacopœia* directs that only half a pint should be made at once. In the late edition the proportions of alcohol and water are varied to meet this difficulty, doubtless as the result of experiments.

Of this group *Huxham's tincture of cinchona* holds pre-eminence as a popular tonic, though it and the simple tincture of (yellow) cinchona, a most unsightly preparation, are both being superseded in many circles by the more elegant "elixirs of bark" recently introduced; it should be also noticed that both the simple and compound tinctures are now made with alcohol three parts, water one part, and that both the saffron and red saunders have been omitted from the compound tincture; the change in menstruum is in accord with the opinion of pharmacists of great experience and good judgment.

GROUP 5.—With diluted alcohol: cathartics, and stomachics. Doses, f℥j to f℥ss.

Officinal Name.	Proportions.	Dose.	Med. Properties, etc.
Tinct. hellebori	℥ij to Oj	f℥j	Emmenagogue, cathart.
" jalapæ	℥iij to Oj { alcohol 2 p. water 1 p.	do.	Cathartic used in combination.
" rhei	{ rhubarb ℥iss, cardamom ℥ij } to Oj	f℥ss	Tonic, cathartic.
" " et sennæ	{ rhubarb ℥ss, senna ℥j, coriander ℥ss, fennel ℥ss, liquorice gr. xv, raisins ℥iij } to Oiss	do.	Carminative, laxative. (Warner's Cordial.)
" aloës	{ soc. aloes ℥ss, liquorice ℥iss } alco. f℥iv, water f℥xij	do.	Cathartic.

Tinctures of hellebore and of jalap are rarely prescribed, especially the latter, which is not miscible with aqueous liquids without precipitation.

Two compound tinctures of rhubarb which were officinal in the older *Pharmacopœias*, have been omitted from the late edition, as also the tincture of senna and jalap; they were little prescribed.

The tincture of rhubarb and senna is directed to be made by maceration, but, with the exception of the raisins, which should be separately macerated in the tincture, the ingredients, if properly powdered and mixed, are well adapted to displacement.

Tincture of aloes is so very disgusting that few physicians with due regard for their patients will inflict it upon them, especially as vinum aloes is so superior to it. Several infusions containing aloes are given under the head of Unofficinal Infusions.

The doses named in the tables may be considered as average adult doses; it is impossible to state their variations in a syllabus.

GROUP 6.—Resinous Tinctures, made with strong alcohol, incompatible with aqueous liquids. Doses, f℥ss to f℥ij.

Officinal name.	Proportions.	Dose.	Medical properties.
Tinctura myrrhæ	℥iij to Oij	f℥j	Astringent, emmenagogue.
" aloës et myrrhæ	{ aloes ℥iss, saffron ℥ss, myrrh ℥iss }	f℥j	Laxative, emmenagogue. (Elixir proprietatis.)
" guaiaci	℥iij to Oj	f℥ij	Alterative, diaphoretic.
" assafœtida	℥ij to Oj	f℥j	Antispasmodic.
" castorei	℥j to Oj	f℥ss	"
" lupulinæ	℥ij to Oj	f℥j	Tonic, narcotic.
" tolutani	℥iss to Oj	f℥ss	Stimulant, expectorant.
" benzoini	℥iij to Oj	f℥ss	" "
" benzoini comp.	{ benzoin ℥iss, storax ℥j, bals. tolu ℥ss, aloes ℥ij } to Oj	f℥ss	" " (*See* Turlington's balsam.)
" zingiberis	℥iv to Oj	f℥j	Carminative.

Tinctures of this group are all incompatible with aqueous liquids, which, by rendering the resinous ingredient insoluble, precipitate it.

Notwithstanding this apparent disadvantage, they may be added to aqueous mixtures, where sugar or gum are added as excipients. Some of the resinous tinctures are much given on sugar, which is allowed to dissolve slowly in the mouth; they may also be given in milk.

Tinctures of tolu and ginger are used in the preparation of the officinal tolu and ginger syrups. The latter is extensively known as essence of ginger, and is one of the most popular of carminatives.

Tincture of myrrh is almost exclusively used in the composition of gargles and mouth-washes, its stimulant and astringent properties fitting it to these uses. *Tincture of guaiac* is remarkable for the green color of the precipitate produced on its addition to milk, which is the usual vehicle in which it is administered. The patient is apt to be alarmed at this appearance unless previously informed of it.

The solutions of camphor and essential oils in alcohol are placed, by the last revision of the *Pharmacopœia*, under the general head *Spiritus*.

GROUP 7.—Ammoniated or Volatile Tinctures, made with aromatic spirit of ammonia.

Tinct. guaiaci ammoniata	℥iv to Oiss	Stimulating diaphoretic,	Dose, f℥j.
" valerianæ "	℥ij to Oj	Antispasmodic,	do.

Aromatic spirit of ammonia, itself an admirable stimulant and antacid, and extensively used as a remedy for sick headache, is used as a menstruum in this class of tinctures; it has the advantage, for the quantity of carbonate of ammonia it contains, of increasing the solubility of resinous bodies, and also adding to their stimulating effects and comparative medicinal efficiency in certain cases.

Volatile tincture of guaiac is prescribed in gouty affections with an acid diathesis.

Volatile tincture of Valerian has been almost superseded, of late, by Pierlot's solution and elixir of valerianate of ammonia; yet the diffusible character of the ammoniacal spirit is well adapted to add efficiency to this noted antispasmodic root, and when the tincture is carefully prepared with fresh materials, it is a most valuable remedy; the percolator should be covered to prevent loss of the volatile ingredient.

WORKING FORMULAS FOR PREPARING THE TINCTURES.

From the U. S. Pharmacopœia.

Tinctura Aconiti Radicis, U. S. P.

Take of Aconite root, in fine powder, twelve troyounces.
Alcohol, a sufficient quantity.

Moisten the powder with six fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained.

Tinctura Aloës, U. S. P.

Take of Socotrine aloes, in fine powder, a troyounce.
Liquorice, three troyounces.
Alcohol, half a pint.
Distilled water, a pint and a half.

Macerate for seven days, and filter through paper.

Tinctura Aloës et Myrrhæ, U. S. P.

Take of Socotrine aloes, in moderately fine powder,
Myrrh, in moderately fine powder, each, three troyounces.
Alcohol, a sufficient quantity.

Mix the powders, and having moistened the mixture with two fluidounces of alcohol, pack it moderately in a conical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained.

This tincture may also be prepared by macerating the powders with two pints of alcohol for seven days, and filtering through paper.

Tinctura Arnicæ, U. S. P.

Take of Arnica, six troyounces.
Alcohol, a pint and a half.
Water, half a pint.
Diluted alcohol, a sufficient quantity.

Mix the alcohol and water, and, having moistened the arnica slightly with a portion of the mixture, bruise it thoroughly in a mortar. Then pack it firmly in a cylindrical percolator, and pour upon it, first the remainder of the mixture, and afterwards sufficient diluted alcohol to make the tincture measure two pints.

Tinctura Assafœtidæ,* U. S. P.

Take of Assafœtida, bruised, four troyounces.
Alcohol, two pints.

Macerate for seven days, and filter through paper.

Tinctura Aurantii. U. S. P. (*Tincture of Orange Peel.*)

Take of Bitter orange peel, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol. Pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Belladonnæ, U. S. P.

Take of Belladonna leaves, recently dried and in fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

* Tincture of assafœtida may be rapidly prepared by introducing the gum resin into a mortar, and pouring on to it about an equal quantity of boiling water, triturating into a paste, then adding alcohol to make up the required quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Benzoini, U. S. P. (*Tincture of Benzoin.*)

Take of Benzoin, in moderately coarse powder, six troyounces.
Alcohol, two pints.

Macerate for seven days, and filter through paper.

Tinctura Benzoini Composita, U. S. P.

Take of Benzoin, in coarse powder, three troyounces.
Socotrine aloes, in coarse powder, half a troyounce.
Storax, two troyounces.
Balsam of tolu, a troyounce.
Alcohol, two pints.

Macerate for seven days, and filter through paper.

Tinctura Calumbæ, U. S. P. (*Tinctura Colombæ*, U. S. P. 1850.)

Take of Columbo, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, transfer it to a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Cannabis, U. S. P. (*Tincture of Indian Hemp.*)

Take of Extract of hemp, three hundred and sixty grains.
Alcohol, a pint.

Dissolve the extract in the alcohol, and filter through paper.

Tinctura Cantharidis, U. S. P.

Take of Cantharides, in fine powder, a troyounce.
Diluted alcohol, a sufficient quantity.

Moisten the powder with half a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Capsici, U. S. P.

Take of Capsicum, in fine powder, a troyounce.
Diluted alcohol, a sufficient quantity.

Moisten the powder with half a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Cardamomi, U. S. P.

Take of Cardamom, in fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack

it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Cardamomi Composita, U. S. P.

Take of Cardamom, in moderately fine powder, three hundred and sixty grains.
Caraway, in moderately fine powder, one hundred and twenty grains.
Cinnamon, in moderately fine powder, three hundred grains.
Cochineal, in moderately fine powder, sixty grains.
Clarified honey, two troyounces.
Diluted alcohol, a sufficient quantity.

Mix the powders, and, having moistened the mixture with half a fluidounce of diluted alcohol, pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints and six fluidounces of tincture are obtained. Lastly, mix this with the clarified honey, and filter through paper.

Tinctura Castorei, U. S. P.

Take of Castor, bruised, two troyounces.
Alcohol, two pints.

Macerate for seven days, express, and filter through paper.

Tinctura Catechu, U. S. P.

Take of Catechu, in moderately coarse powder, three troyounces.
Cinnamon, in moderately coarse powder, two troyounces.
Diluted alcohol, a sufficient quantity.

Mix the powders, and, having moistened the mixture with a fluidounce of diluted alcohol, pack it in a conical glass percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Cinchonæ, U. S. P.

Take of Yellow cinchona, in moderately fine powder, six troyounces.
Alcohol,
Water, each, a sufficient quantity.

Mix three measures of alcohol with one of water, moisten the powder with two fluidounces of the mixture, pack it firmly in a conical glass percolator, and gradually pour the mixture upon it until two pints of tincture are obtained.

Tinctura Cinchonæ Composita, U. S. P. (*Huxham's Tincture of Bark.*)

Take of Red cinchona, in moderately fine powder, four troyounces.
Bitter orange peel, in moderately fine powder, three troyounces.
Serpentaria, in moderately fine powder, three hundred and sixty grains.
Alcohol,
Water, each, a sufficient quantity.

Mix three measures of alcohol with one of water. Mix the powders, and, having moistened the mixture with four fluidounces of the menstruum, pack it firmly in a conical glass percolator, and gradually pour upon it the menstruum, until two pints and a half of tincture are obtained.

Tinctura Cinnamomi, U. S. P.

Take of Cinnamon, in fine powder, three troyounces.
Alcohol,
Water, each, a sufficient quantity.

Mix two measures of alcohol with one of water. Then moisten the powder with a fluidounce of the mixture, pack it moderately in a conical percolator, and gradually pour the mixture upon it until two pints of filtered liquid are obtained.

Tinctura Colchici, U. S. P.

Take of Cholchicum seed, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Conii, U. S. P.

Take of Conium leaves, recently dried and in fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Cubebæ, U. S. P.

Take of Cubebs, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Digitalis, U. S. P.

Take of Digitalis, recently dried and in fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Gallæ, U. S. P.

Take of Nutgall, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a glass percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Gentianæ Composita, U. S. P.

Take of Gentian, in moderately fine powder, two troyounces.
Bitter orange peel, in moderately fine powder, a troyounce.
Cardamom, in moderately fine powder, half a troyounce.
Diluted alcohol, a sufficient quantity.

Mix the powders, and, having moistened the mixture with a fluidounce and a half of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Guaiaci, U. S. P.

Take of Guaiac, in moderately coarse powder, six troyounces.
Alcohol, a sufficient quantity.

Mix the powder thoroughly with an equal bulk of dry sand, pack the mixture moderately in a conical percolator, and, having covered it with a layer of sand, gradually pour alcohol upon it until two pints of tincture are obtained.

Tinctura Guaiaci Ammoniata, U. S. P. (*Volatile Tincture of Guaiac.*)

Take of Guaiac, in moderately coarse powder, six troyounces.
Aromatic spirit of ammonia, two pints.

Macerate for seven days in a close vessel, and filter through paper.

Tinctura Guaiaci Glycerinata.

Take of Purified Guaiac resin	℥ij.
Alcohol	f℥iij.
Solution of potassa	f℥ij.
Glycerin	f℥xj.

Dissolve the guaiac in the alcohol, add the liquor potassa and then the glycerin.

Tinctura Hellebori, U. S. P.

Take of Black Helleborne, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Humuli, U. S. P.

Take of Hops, in moderately coarse powder, five troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it very firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Hyoscyami, U. S. P.

Take of Hyoscyamus leaves recently dried, in fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Iodinii, U. S. P. (*Tincture of Iodine.*)

Take of Iodine, a troyounce.
Alcohol, a pint.

Dissolve the iodine in the alcohol.

Tinctura Iodinii Composita, U. S. P.

Take of Iodine, half a troyounce.
Iodide of potassium, a troyounce.
Alcohol, a pint.

Dissolve the iodine and iodide of potassium in the alcohol.

Tinctura Jalapæ, U. S. P.

Take of Jalap, in fine powder, six troyounces.
Alcohol,
Water, each, a sufficient quantity.

Mix two measures of alcohol with one of water. Then moisten the powder with two fluidounces of the mixture, pack it moderately in a cylindrical percolator, and gradually pour the mixture upon it until two pints of tincture are obtained.

Tinctura Kino, U. S. P.

Take of Kino, in fine powder, three hundred and sixty grains.
Alcohol,
Water, each, a sufficient quantity.

Mix two measures of alcohol with one of water. Then mix the powder thoroughly with an equal bulk of dry sand, and having introduced the mixture into a conical glass percolator, gradually pour the menstruum upon it until half a pint of tincture is obtained.

Tinctura Krameriæ, U. S. P.

Take of Rhatany, in moderately fine powder, six troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it in a cylindrical glass percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Lobeliæ, U. S. P.

Take of Lobelia, in fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of diluted alcohol, pack it firmly in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Lupulinæ, U. S. P.

Take of Lupulin, four troyounces.
Alcohol, a sufficient quantity.

Pack the lupulin in a narrow cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained.

Tinctura Myrrhæ,* U. S. P.

Take of Myrrh, in moderately coarse powder, three troyounces.
Alcohol, a sufficient quantity.

Introduce the powder into a conical percolator, press it moderately, and gradually pour alcohol upon it until two pints of tincture are obtained.

Tinctura Nucis Vomicæ, U. S. P.

Take of Nux vomica, in fine powder, eight troyounces.
Alcohol, a sufficient quantity.

Mix the powder with a pint of alcohol, and digest for twenty-four hours, in a close vessel, with a gentle heat; then transfer the mixture to a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained.

Tinctura Quassiæ, U. S. P.

Take of Quassia, in moderately fine powder, two troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Rhei, U. S. P.

Take of Rhubarb, in moderately coarse powder, three troyounces.
Cardamom, in moderately fine powder, half a troyounce.
Diluted alcohol, a sufficient quantity.

Mix the powders, and, having moistened the mixture with a fluidounce of diluted alcohol, pack it moderately in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Rhei et Sennæ, U. S. P.

Take of Rhubarb, in moderately coarse powder, a troyounce.
Senna, in moderately coarse powder, one hundred and twenty grains.
Coriander, in moderately coarse powder,
Fennel, in moderately coarse powder, each, sixty grains.
Liquorice, in moderately coarse powder, thirty grains.
Raisins, deprived of their seeds, six troyounces.
Diluted alcohol, three pints.

Macerate for seven days, express, and filter through paper.

* Tincture of myrrh may be prepared with facility by pouring on the crude myrrh in a mortar about an equal quantity of boiling water and triturating into a paste, then adding alcohol to make the required quantity of the tincture.

Tinctura Sanguinariæ, U. S. P.

Take of Bloodroot, in moderately fine powder, four troyounces.
Alcohol,
Water, each, a sufficient quantity.

Mix three measures of alcohol with one of water. Moisten the powder with a fluidounce of the mixture, pack it in a conical percolator, and gradually pour the menstruum upon it until two pints of tincture are obtained.

Tinctura Scillæ, U. S. P.

Take of Squill, in moderately coarse powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Serpentariæ, U. S. P.

Take of Serpentaria, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Stramonii, U. S. P.

Take of Stramonium seed, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Tolutana, U. S. P.

Take of Balsam of tolu, three troyounces.
Alcohol, two pints.

Macerate the balsam with the alcohol until it is dissolved; then filter through paper.

Tinctura Valerianæ, U. S. P.

Take of Valerian, in moderately fine powder, four troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with a fluidounce of diluted alcohol, pack it in a conical percolator, and gradually pour diluted alcohol upon it until two pints of tincture are obtained.

Tinctura Valerianæ Ammoniata, U. S. P. (*Ammoniated Tincture of Valerian.*)

Take of Valerian, in moderately fine powder, four troyounces.
Aromatic spirit of ammonia, two pints.

Macerate for seven days, express, and filter through paper.

It should be remembered that this preparation should be macerated and filtered in close vessels.

Tinctura Veratri Viridis, U. S. P.

Take of American hellebore, in moderately fine powder, sixteen troyounces.
Alcohol, a sufficient quantity.

Moisten the powder with four fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained.

Tinctura Zingiberis, U. S. P. (*Essence of Ginger.*)

Take of Ginger, in fine powder, eight troyounces.
Alcohol, a sufficient quantity.

Moisten the powder with two fluidounces of alcohol, pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until two pints of tincture are obtained.

Selections of Tinctures not Officinal in the U. S. Pharmacopœia.

Tinctura Ferri Amara. (*Dr. Physick's Bitter Tincture of Iron.*)

Take of	Iron filings	℥iij.
	Bruised ginger,	
	" gentian, of each	℥j.
	" orange-peel	ʒss.

Infuse in one pint of old cider for two weeks, in a bottle without a stopper, and filter.

Modified Formula for the above.

Take of	Iron filings	℥iij.
	Old cider	Oj.
	Acetic acid	f℥j.
	Citric acid	ʒss.
	Ginger, in coarse powder	℥iv.
	Gentian, in coarse powder	℥iv.
	Orange-peel, in coarse powder	ʒij.
	Alcohol	Oij.
	Water	Oj.

To the iron filings in a wide-mouth bottle add the cider and acetic acid; digest for several hours by the aid of a moderate heat. Percolate the aromatics with the mixed alcohol and water. Add the citric acid to the cider preparation, mix it with the aromatic tincture, and after a few hours pour off the clear liquor, filter the remainder into this, and bottle for use. As thus made, this preparation has a rich wine color, becoming darker by age, but not black and grumous like the foregoing.

Though not a handsome tincture, this famous chalybeate tonic is still esteemed as most efficient.

Tinctura Cinchonæ Ferrata.

On account of the large number of cases in which the tonic effects of cinchona and aromatics are indicated with ferruginous preparations, it has been deemed desirable to contrive a method of combining these without producing the inky and grumous appearance resulting from the diffusion of tannate of iron in the preparation; following the publication of formulas for this combination an extensive demand occurred for ferrated tincture of bark, which has only subsided with the introduction of bitter wine of iron, wine of citrate of iron and quinia, and other more desirable preparations. Of the several processes recommended, that given among the tonic liquid preparations, in Part VI. of this work, is recommended as a simple and satisfactory extemporaneous process.

Tinctura Quininæ. (Br. Ph.)

Take of Sulphate of quinia	160 grains.
Tincture of orange-peel	Oj (imperial measure).

Digest for seven days, or till dissolved.

Dose, f℥j, containing a grain of the quinia salt.

Tinctura Strychniæ.

Take of Strychnia	gr. iij.
Alcohol	f℥j.

Make a tincture.

Dose, ♏v to xvj.

This is perhaps about the strength of tincture of nux vomica (as shown below), for which it is sometimes substituted.

Name.	Proportions.	Dose.
Tinctura nucis vomicæ, *U. S.*	℥iv to Oj alc.,	5 to 15 minims.
" strychnia,	gr. iij to f℥j (16 minims = $\frac{1}{10}$ grain),	do.

Flemming's Tincture of Aconite.

Take of Aconite root (dried and finely powdered) . . .	℥xvj.
Rectified spirits	Sufficient.

Macerate for four days with sixteen ounces of the spirits, then pack into a percolator, add more until twenty-four fluidounces of tincture are obtained.

This is the strongest of the tinctures of aconite; it is compared with the others in the following syllabus:—

Name.	Proportions.	Dose.
Tinctura aconiti folii, *U. S. P.*,	℥ij leaves to Oj dil. alc.,	20 to 30 drops.
" " radicis, *U. S. P.*,	℥vj root to Oj alcohol,	5 drops.
" " (Flemming's),	℥viij root to f℥xij do.,	3 to 5 drops.

There is not perhaps so great a difference between the last two as their relative proportions would indicate, both being nearly saturated. Care should be taken to distinguish these by their full names in prescribing and labelling.

Tinctura Matico. (Dublin Ph.)

Take of Matico leaves, in coarse powder . . 8 ounces (commercial).
Proof spirit . . . . . 2 pints (imp. measure).

Macerate fourteen days, strain, express, and filter.

Dose, from f℥j to f℥iij. Used as an alterative stimulant and hæmostatic.

Dewees's Tincture of Guaiacum.

Take of Guaiacum resin . . . . . ℥iv.
Carbonate of potassium . . . . . ℥iss.
Pulv. pimento . . . . . ℥j.
Diluted alcohol . . . . . Oij.

Digest for two weeks. Dose, from f℥j to f℥ij.

Tinctura Rhei Aromatica. (*Noble's Tonic Elixir.*)

Take of Rhubarb,
Caraway,
Orange-peel, of each . . . . . ℥ij.
Brandy . . . . . Oij.

Macerate for two weeks or displace. Dose, f℥j to f℥ss.

Tinctura Rhei Dulcis.

Take of Rhubarb, in moderately coarse powder . . . . . ℥ij.
Anise seed,
Liquorice root, in moderately coarse powder, of each ℥j.
Sugar . . . . . ℥ij.
Diluted alcohol . . . . . Sufficient.

Macerate the ingredients in a conical percolator, after they have been moistened with three fluidounces of the menstruum for twenty-four hours, then pour on the menstruum until two and a half pints of tincture have been obtained.

Tinctura Moschi (*Medicinal*). Deschamp.

Take of Musk (in grain) . . . . . 1 part.
Alcohol (56 per cent.) . . . . . 5 parts.

Macerate together for fourteen days, or until needed for use, and filter.

Ethereal Tinctures.

The use of the several forms of ether as menstrua in tinctures is objectionable, owing to the variations in strength to which these are liable from the rapid evaporation of the ether, even at ordinary temperatures, and in the transfer of the liquid from the bottles; yet the solvent action of ether and its diffusible character adapt it to combination with certain remedies.

The following preparations, prescribed by Dr. Mettauer, of Virginia, containing *spt. ætheris nitrosi*, are selected, having proved useful in medical practice.

Mettauer's Ethereal Tincture of Cantharides.

Take of Cantharidis pulv.	ʒiij.
Spt. æther. nit.	Oiiss.

Macerate for eight days, and filter.

The ethereous menstruum seems to promote the tendency of the flies to the genito-urinary organs without producing strangury. It is also used as a blister for the scalp of infants.

Mettauer's Ethereal Tincture of Cubebs.

Take of Cubebæ pulv.	ʒiv.
Spt. ætheris nit.	Oij.

Macerate for eight days, and filter.

Used for subacute inflammation of the bladder, urethra, etc., and of the mucous lining of the stomach and bowels. Dr. M. also uses spirit of nitrous ether as a menstruum for colchicum, guaiac, squill, ergot, ipecac., etc.

Ethereal Tincture of Guaiacum.

Take of Resin guaiacum	3 troyounces.
Spirit of nitrous ether	1 pint, or q. s.

Treat by displacement or maceration, till one pint of the tincture is obtained.

Dose, a teaspoonful.

Ethereal Tincture of Colchicum.

Take of Colchicum	6 troyounces.
Spirit of nitrous ether	1 pint, or q. s.

Treat by displacement or maceration, till one pint of the tincture is obtained.

Dose, 20 to 30 drops.

Ethereal Tincture of Cannabis Indica.

Take of Squire's extract of cannabis	Half an ounce.
Spirit of nitrous ether	Half a pint.

Triturate together in a mortar, till the extract is dissolved.

Dose, 5 to 15 drops.

The foregoing preparations of guaiacum, colchicum, and cannabis are used jointly for rheumatic and neuralgic symptoms. (*See* Extemporaneous Prescriptions.) They are also well adapted to replace the alcoholic tinctures of the same drugs for most general purposes.

Asiatic Tincture for Cholera.

Take of Opium, in powder	ʒj.
Camphor	ʒj.
Oil of Cloves	fʒj.
Capsicum, in powder	ʒj.
Hoffmann's anodyne	Oj.

Macerate ten to twenty days, or prepare by percolation in a close percolator.

This is a most valuable application of the Ethereal Liquor of Hoffmann, the diffusible character of which is admirably adapted to heighten the effect of the powerful stimulants prescribed. It has attained considerable celebrity within several years past.

Adult dose, 20 to 60 drops every second, third, or fourth hour, according to circumstances, in a little sweetened water.

CHAPTER VIII.

MEDICATED WINES, VINEGARS, ELIXIRS, AND CORDIALS.

Vina, *U. S. P.*

This class of Galenical solutions is less numerous than the tinctures, to which it is closely allied.

There are two kinds of wine officinal in the *U. S. Pharmacopœia; vinum xericum* (vinum album of the former *Pharmacopœia*), which is sherry wine (Teneriffe and Madeira are sometimes used in its stead), and *vinum portense*, which is port wine. The former contains about 20 per cent. of alcohol, sp. gr. .825, and the latter near 26 per cent.

In all the medicated wines which are officinal, sherry wine is directed as the menstruum. This is a clear, amber-colored liquid, having an agreeable pungent taste, and destitute of acidity. It possesses the advantage over either alcohol or diluted alcohol, of being less stimulating, and more agreeable in its taste and in its effects on the system. It is chiefly objectionable as a substitute for diluted alcohol, from its liability to decompose when impregnated with the soluble principles of plants. To meet this objection, it is customary with some to add from one to two fluidounces of alcohol to a pint of the wine, and this course is directed in the *Pharmacopœia* in the case of vinum rhei.

Syllabus of the Officinal Medicated Wines.

Officinal name.	Proportions.	Dose.	Med. properties.
Vinum aloes	to Oj { ℥j + cardamon, ginger, āā ʒj }	fʒij to fℨij	Carminative, aperient.
" rhei	to Oj { ℥ij + canella ʒj, dil. alc. fʒij }	fʒj to fℨss	do.
" colchici radicis	℥vj to Oj	gtt. x to fʒj	Diuretic, nerv. sedative.
" " seminis	℥ij do.	fʒj to fℨij	do.
" ergotæ	fʒij of fluid extract to Oj	fʒj	Parturient.
" ipecacuanhæ	fʒj do. do. do.	fʒj to fℨss	Expectorant.
" tabaci	ʒj to Oj	gtt. xx	Diuretic, sedat.
" antimonii	2 grs. tart. emet. to fʒj	fʒj to fℨss	Expect., emet.

REMARKS ON THE MEDICATED WINES.

The two *wines of colchicum* are much prescribed in rheumatic and gouty affections; that of the root, as seen in the syllabus, is much the stronger. Prepared according to the working formula appended, from the *Pharmacopœia*, it furnishes a very efficient preparation. The wine of the seed should be made of the fresh and well-preserved seed; it is preferred by some as a more uniform preparation. Large quantities of wine of fresh colchicum root are imported from England, and it is said to be more efficient than that prepared of the dried root. Some of the best pharmacists in England, however, prefer to use the recently dried root as furnishing uniform and satisfactory results.

Antimonial wine is made by trituration in a mortar, owing to the comparative insolubility of the tartrate of antimony and potassium in alcoholic liquids. The late edition of the *Pharmacopœia* directs a small portion of boiling water to be added to the salt, and this solution to the wine.

Wine of ipecacuanha is an elegant and very popular preparation, being much used by itself, and with other expectorant and diaphoretic remedies; it is not as depressing in its effects as wine of antimony, and yet about equally efficacious as an emetic and nauseant. It will be observed that it is directed to be made by adding a fluidounce of the fluid extract to fifteen fluidounces of wine.

Wine of ergot is perhaps more used than any other preparation of that drug; it has no other fault than its proneness to decompose in hot weather, which makes it necessary to add a little strong alcohol, or to keep it in a cool place, and in well-stopped bottles. This is now directed, like the last mentioned preparation, to be made by adding the fluid extract to wine in the proportion of f℥ij to f℥xiv of wine.

Working Formulas from the U. S. Pharmacopœia.

Vinum Aloës. (*Wine of Aloes.*) U. S. P.

Take of Socotrine aloes, in fine powder, a troyounce.
Cardamom, in moderately fine powder,
Ginger, in moderately fine powder, each, sixty grains.
Sherry wine, a pint.

Macerate for seven days, with occasional agitation, and filter through paper.

Vinum Antimonii. (*Wine of Antimony.*) U. S. P.

Take of Tartrate of antimony and potassium, thirty-two grains.
Boiling distilled water, a fluidounce.
Sherry wine, a sufficient quantity.

Dissolve the salt in the distilled water, and, while the solution is hot, add sufficient sherry wine to make it measure a pint.

Vinum Colchici Radicis. (*Wine of Colchicum Root.*) U. S. P.

Take of Colchicum root, in moderately fine powder, twelve troyounces.
Sherry wine, a sufficient quantity.

Moisten the powder with four fluidounces of sherry wine, pack it firmly in a conical percolator, and gradually pour sherry wine upon it until two pints of filtered liquid are obtained.

Vinum Colchici Seminis. (*Wine of Colchicum Seed.*) U. S. P.

Take of Colchicum seed, in moderately coarse powder, four troyounces.
Sherry wine, two pints.

Macerate for seven days, with occasional agitation; then express, and filter through paper.

Vinum Ergotæ. (*Wine of Ergot.*) U. S. P.

Take of Fluid extract ergot, four fluidounces.
Sherry wine, twenty-eight fluidounces.

Mix, and filter through paper.

Vinum Ipecacuanhæ. (*Wine of Ipecacuanha.*) U. S. P.

Take of Fluid extract ipecacuanha, two fluidounces.
Sherry wine, thirty fluidounces.

Mix them, and filter through paper.

Vinum Rhei. (*Wine of Rhubarb.*) U. S. P.

Take of Rhubarb, in moderately coarse powder, two troyounces.
Canella, in moderately fine powder, sixty grains.
Sherry wine, fourteen fluidounces.
Diluted alcohol, a sufficient quantity.

Mix two fluidounces of diluted alcohol with the sherry wine, and moisten the powders, previously rubbed together, with half a fluidounce of the mixture; then transfer them to a conical percolator, and gradually pour upon them the remainder of the mixture, and afterwards diluted alcohol, until a pint of filtered liquid is obtained.

Vinum Tabaci. (*Wine of Tobacco.*) U. S. P.

Take of Tobacco, in moderately fine powder, a troyounce.
Sherry wine, a pint.

Macerate for seven days, with occasional agitation; then express, and filter through paper.

Wines not Officinal in U. S. P.

Aromatic Wine.

Take of Wormwood, peppermint,
Rosemary, thyme,
Hyssop, sage,
Lavender, sweet marjoram, of each, . ʒij.
Port wine . . . . . Oij.

Macerate seven days, transfer to a percolator, and displace.

The principal use of aromatic wine is as an astringent and stimulating wash, applied particularly to buboes.

Vinum Ergotæ Saturatum.

Take of Ergot, recently powdered, ℥iiiss.
Sherry wine, a sufficient quantity.

Moisten the ergot with a fluidounce of the wine, transfer to a conical percolator, pack firmly, and slowly displace one pint.

This preparation has been long in use as a most efficient parturient and valuable antihemorrhagic.

Wine of Wild Cherry Bark.

Take of Alcoholic extract (from 24 ounces) of wild cherry bark, about	℥vss.
Sweet almonds	℥iij.
Water	1 pint.
Sherry wine	2 pints.

Beat the almonds with the water to a paste, rub down the extract with half a pint of the wine, and mix the two liquids in a bottle of the capacity of three pints, stop it closely, and permit it to stand for three days, with occasional agitation; then add the remainder of the wine, allow it to stand a week, and filter. By this mode of proceeding, opportunity is afforded for the development of the hydrocyanic acid before the menstruum is made so alcoholic as to retard the reaction which favors its formation.

Thus made, the wine of wild cherry bark is a transparent, wine-red liquid, having an astringent, bitter almond taste and odor, much less agreeable than the syrup, and of about the same strength.

The dose of this preparation as a tonic and sedative is a teaspoonful.

Wine of Tar—Tar Beer—Jews' Beer. (Prof. Procter.)

Take of Ground malt, honey, and tar, of each, one pound.
Yeast, half a pint.
Water, a sufficient quantity.

Mix the malt, honey, and three quarts of the water in an earthen vessel, keep them at the temperature of 150° F. (about), with occasional stirring for three hours, then suffer the whole to cool to about 80° F., and add the yeast.

Fermentation soon sets in, and should be promoted by maintaining the temperature at between 70° and 80° F. during thirty-six hours. The supernatant fluid should then be decanted from the dregs of the malt, and the tar added gradually to these in a small stream, stirring constantly so as to distribute it uniformly among them, and prevent its conglomerating in masses. The decanted fluid is then returned to the vessel, and the whole well stirred up from time to time, for several days or a week, observing to add water occasionally to keep the original measure. The whole is then thrown on a piece of Canton flannel or other close strainer, the fluid allowed to pass, and the dregs expressed strongly to re-

move as much as possible of the fluid inclosed. The expressed liquid is then filtered for use; there is an advantage in allowing it to stand until it gets nearly clear by subsidence, before filtering it. When first made, before filtering, wine of tar has but little color, but soon acquires a reddish-brown hue by exposure. It smells and tastes strongly of tar, is slightly acid, is not unpleasant to most persons, and, when prepared as above, is undoubtedly a valuable auxiliary to the physician in pulmonary diseases.

The dose of wine of tar is a tablespoonful.

Wine of Iron. (T. Weaver.)

Take of	Citrate of iron*	128 grains.
	Sherry wine	12 fluidounces.
	Hot water, and	
	Sugar, of each	Sufficient.
	Tincture of orange-peel, to make 1 pint.	

Dissolve the citrate in hot water, and add to it the other ingredients in proportion to suit the taste.

Dose, a teaspoonful, containing a grain of the iron salt.

Wine of Citrate of Iron and Quinine.

Take of	Citrate of iron and quinine . . .	384 grains.
	Hot water	A fluidounce.
	Flavor of orange	Half a fluidounce.
	Sherry wine	Sufficient to make a pint.

Dissolve the citrate in the hot water, add the wine and flavor of orange, and filter.

Dose, a teaspoonful, containing three grains of the iron and quinine salt.

Bitter Wine of Iron. (T. Weaver.)

Take of	Citrate of iron	128 grains.
	Extract of calisaya (Ellis)	16 grains.
	Citric acid,	
	Hot water,	
	Sugar, and	
	Tincture of orange-peel, to taste.	
	Sherry wine, to make 1 pint.	

Dissolve the citrate of iron and extract of cinchona separately in hot water, adding a small excess of citric acid; then add the sugar and tincture of orange-peel, and lastly the wine. The chief secret in preserving the bouquet of the wine in contact with the iron salt is to add it after the utmost dilution.

Dose, a teaspoonful, containing one grain of the iron salt and one-eighth of a grain of the extract.

Wine of Pepsin.

Take of the cleaned inner coating or membrane of fresh hogs' stomachs; digest this in sherry wine in the proportion of half a pint

* For this may be substituted an equivalent quantity of the officinal solution of citrate of iron. Citrate of magnetic oxide of iron is preferred by some.

of wine to each stomach used. After macerating three days, pour off the wine from the stomach membranes, and digest them again in half the quantity of wine for three days, pour off the wine, and express; mix this with the first fluid obtained, and filter. This liquid should now be diluted so that one fluidrachm shall digest in four or six hours one hundred grains of coagulated albumen previously mixed with one fluidounce of distilled water acidulated with six drops of muriatic acid.

ACETA, *U. S. P.*

Acetum (vinegar) is officinal in the list of the *U. S. Pharmacopœia;* it is described as "impure diluted acetic acid prepared by fermentation;" it is too familiar to require description. Vinegar is chiefly useful in pharmacy for furnishing *acetum destillatum*, which is made by distillation, by means of a sand-bath, from a glass retort into a glass receiver, rejecting from each gallon the last pint, which contains the impurities. This liquid, which is nearly pure *weak* acetic acid, has about the same strength as the crude vinegar from which it is obtained, and possesses the same saturating power; one hundred grains should saturate not less than 7.6 grains of bicarbonate of potassium.

Distilled vinegar was formerly used as the menstruum for the officinal *aceta*, but in the last two revisions of the *Pharmacopœia* it it has been superseded by *diluted acetic acid.*

The chief reason for this change has been that the latter liquid is cheaper and much more easily obtained. The immense production of *acetic acid* for use in the arts as well as in medicine, has reduced its price to a much lower point than formerly. The small bulk of the strong acid recommends it for transportation, and it may be readily and immediately diluted to the point desired. It is free from organic impurities, while the ordinary product of the distillation of vinegar is not, as shown by the fact that, while the latter is apt to turn brown on the addition of an alkali, the former remains clear and colorless.

For an account of acetic acid, the chief impurities found in the commercial article and the modes of testing it, the reader is referred to Part IV. of this work.

Acidum Aceticum Dilutum.—This liquid is made by adding to one part of acetic acid seven parts of water (making eight parts), so that the proportions may be stated as one part of strong acid in every eight parts of diluted. As 60 grains of bicarbonate of potassium saturate 100 grains of the strong acid, $7\frac{1}{2}$ grains (one-eighth of sixty) will saturate the same quantity of the diluted acid; or, observing very nearly the same proportion, 35 grains will saturate one fluidounce.

The use of diluted acetic acid as a menstruum is confined by the *U. S. Pharmacopœia* to squill, lobelia, sanguinaria, and opium. It is, however, used in the preparation of the fluid extracts of ergot, and in the solid extract of colchicum, and ammoniac plaster.

It forms an admirable menstruum for *squill*, its acid taste recom-

mending it over both water and alcohol, and its medicinal action promoting that of squill in most cases to which that medicine is adapted.

Sanguinaria and *lobelia* are for the first time introduced into the class in the edition of the *Pharmacopœia* of 1860; both these drugs contain alkaloids which are fixed in the preparation by the acetic acid.

In the case of *opium*, the object in employing this acid is to assist in dissolving and extracting the morphia, with which it combines, furnishing a soluble salt, and one which is considered by some as more desirable than the meconate, as it exists in laudanum and other solutions prepared with neutral menstrua.

The addition of acetic acid as an antiseptic to several of the syrups most liable to ferment has recently been recommended, and it is found to serve a useful purpose not only in preventing fermentation, but also in qualifying the cloying sweetness, which is an objection to this form of preparation.

The antiseptic properties of diluted acetic acid are inferior to those of diluted alcohol, and on that account these preparations are said to be more liable to change than the tinctures. A small addition of alcohol is sometimes made to obviate this. I have, however, never known either of the officinal "Aceta" to ferment by keeping. A syllabus of this class is appended.

Syllabus of Officinal Vinegars.

Officinal name.	Proportions.	Dose.	Medical properties, etc.
Acetum scillæ	℥ij to Oj	gtt. xxx to f℥ij	Diuretic, sedative, etc.
" lobeliæ	do.	gtt. xxx to f℥j	Expect., narcot., etc.
" sanguinariæ	do.	do.	do. do.
" opii	℥v to Oij	gtt. v to x	*See* Preparations of Opium.

Working Formulas from the U. S. Pharmacopœia.

Acetum Sanguinariæ. (*Vinegar of Bloodroot.*) U. S. P.

Take of Bloodroot, in moderately coarse powder, four troyounces.
Diluted acetic acid, a sufficient quantity.

Moisten the powder with two fluidounces of diluted acetic acid, pack it firmly in a conical glass percolator, and gradually pour upon it diluted acetic acid until the filtered liquid measures two pints.

Vinegar of bloodroot may also be prepared by macerating the powder with two pints of diluted acetic acid for seven days, expressing the liquid, and filtering through paper.

Acetum Scillæ. (*Vinegar of Squill.*) U. S. P.

Take of Squill, in moderately coarse powder, four troyounces.
Diluted acetic acid, a sufficient quantity.

Moisten the powder with a fluidounce of diluted acetic acid, pack it in a conical glass percolator, and gradually pour upon it diluted acetic acid until the filtered liquid measures two pints.

Acetum Lobeliæ. (*Vinegar of Lobelia.*) U. S. P.

Take of Lobelia, in moderately coarse powder, four troyounces.
Diluted acetic acid, a sufficient quantity.

Moisten the powder with two fluidounces of diluted acetic acid, pack it firmly in a conical glass percolator, and gradually pour upon it diluted acetic acid until the filtered liquid measures two pints.

Vinegar of lobelia may also be prepared by macerating the powder in two pints of diluted acetic acid for seven days, expressing the liquid, and filtering through paper.

Elixirs and Cordials.

Under these names a variety of unofficinal preparations are sold, most of which are mixtures of aromatic wines and tinctures with sugar, the latter predominating. Preparations of this description are popular in proportion as they are palatable and commend themselves to the taste of the public.

Elixir of Calisaya.

Take of Calisaya bark	One troyounce.
Recent orange-peel	Half a troyounce.
Ceylon cinnamon, Coriander, Angelica seeds, of each	Three drachms.
Caraway, Aniseed, Cochineal, of each	One drachm.
French brandy, and water, of each	A sufficient quantity.
Simple syrup	Ten fluidounces.

Percolate the cinchona and aromatics with the brandy, until ten fluidounces are obtained. Continue the displacement with equal parts of brandy and water, till twenty-two fluidounces are obtained, then add the syrup to bring it up to the measure of two pints.

Ferrated Elixir of Cinchona. (J. T. Shinn.)

Take of Calisaya bark, in powder	Four troyounces.
Cinnamon water	Two pints.
Caraway water	One pint.
Tincture of orange-peel	Half a pint.
Alcohol	Half a pint.
Brandy	Two pints.
Syrup	Three pints.
Soluble pyrophosphate of iron	Two ounces.

Mix the cinnamon water and caraway water with the tincture of orange-peel, and percolate the bark with the mixture. Dissolve the pyrophosphate of iron in the percolate, add the other ingredients, and filter.

This contains about one grain of pyrophoshate of iron (with citrate of ammonia), and two grains of cinchona bark to a drachm.

Ferro Phosphorated Elixir of Calisaya.

Take of	Pyrophosphate of iron	128 grains.
	Extract of calisaya	24 grains.
	Sugar	4 ounces.
	Tinct. of fresh orange-peel	2 fluidounces.
	Water	2 fluidounces.
	Sherry wine	10 fluidounces.

Triturate the iron salt with the extract and sugar till dissolved, then add the tincture and the wine, and filter twice, or till it is perfectly clear.

Dose, a teaspoonful.

This preparation originated in New York, where it enjoys considerable popularity. The formula is that of W. C. Bakes, my valued assistant.

Curaçao Cordial. (L. M. Emanuel.)

Take of	Curaçao bark (bitter orange)	ʒj.
	Peel of sweet oranges	ʒss.
	Cloves,	
	Canella, of each	gr. xv.
	Brandy	Oss.
	Neutral sweet spirits	Oij.
	Distilled orange-flower water	fʒiij.
	Sugar	℔j.

Prepare a tincture by percolation with the aromatics, brandy, and sweet spirits, then add the distilled orange-flower water and the sugar.

Red Curaçao Cordial. (*Improved Formula.*)

Take of	Sweet spirits	1 pint.
	Tincture of orange-peel	Sufficient.
	Syrup	1 pint.
	Oil of juniper,	
	Tincture of saunders, of each, to taste.	

Mix.

The genuine Curaçao cordial is imported from Rotterdam, and is highly esteemed. These recipes form good imitations of it. It is recommended as a remedy for nausea, especially when a symptom of pregnancy.

Elixir of Valerianate of Ammonia. (T. H. K. Enos.)

Take of	Valerianic acid	Two fluidrachms.
	Carbonate of ammonium	Sufficient.
	Alcohol,	
	Syrup, of each	Two fluidounces.
	Ext. orange-peel	Half a fluidounce.
	Orange-flower water	A fluidounce.
	Water	Sufficient to make half a pint.

Dilute the valerianic acid with a fluidounce of water, neutralize with the carbonate of ammonium, then add the alcohol, holding the aromatic extract (?) in solution, then the orange-flower water and water, and filter. (The extract of orange-peel might be superseded

to advantage by tincture of fresh orange-peel.) A fluidrachm, which is the appropriate dose, contains two grains of the salt.

Elixir of Valerianate of Ammonia. (Goddard's.)

Take of	Valerianic acid (from the root)	Six fluidrachms.
	Carbonate of ammonium . .	Sufficient.
	Carbonic acid water . . .	Eight fluidounces.
	Red Curaçao cordial . . .	Twenty fluidounces.
	Orange-flower water . . .	Eight fluidounces.
	Mucilage of gum Arabic . .	Two fluidounces.

Saturate the valerianic acid with the carbonate of ammonium, diluted with the carbonic acid water, then add it to the flavoring ingredients and mucilage, and filter. Dose, a teaspoonful.

Ferrated Tincture of Gentian.

Take of	Gentian, in moderately fine powder,	℥ij.
	Bitter orange-peel, in moderately fine powder,	℥j.
	Cardamom, in moderately fine powder,	℥ss.

Moisten with diluted alcohol, and percolate with a mixture of one part of alcohol and three of water, until four pints of tincture are obtained.

Make hydrated sesquioxide of iron by precipitating four ounces of solution of tersulphate of iron, and wash the precipitate on a filter, then pass the tincture of gentian, bitter orange-peel, and cardamom through the magma on the filter; now add f℥viiiss of solution of citrate of iron (gr. j to ♏), and the preparation is complete. Dose, a teaspoonful, containing one grain of citrate of iron.

Pierlot's Solution of Valerianate of Ammonium. (*Modified Formula.*)

Take of	Extract of valerian	Two scruples.
	Fluid extract of valerian . . .	Two fluidrachms.
	Water	Seven fluidounces.

Dissolve the extract in the fluid extract and water, filter, and add

	Valerianate of ammonium . .	Two drachms.
	Orange-flower water, Simple syrup, of each	Half a fluidounce.

Dose, a teaspoonful.

Propylamin Cordial.

Take of	Chloride of propylamin . . .	96 grains.
	Aniseed water	9 fluidounces.
	Atwood's alcohol	3 fluidounces.
	Simple syrup	4 fluidounces.
	Saffron	Sufficient.

Dissolve the chloride in the aniseed water, add the alcohol and syrup, digest with the saffron, and filter till clear and bright.

Elixir Chloroformi. (*Chloroform Paregoric.*) Dr. H. Hartshorne.

Take of	Chloroform	One and a-half fluidounce.
	Tincture of opium	One and a-half fluidounce.
	Tincture of camphor	One and a-half fluidounce.
	Arom. spt. of ammonia	One and a-half fluidounce.
	Oil of cinnamon	Twenty minims.
	Brandy	Two fluidounces.

Dose, f℥ss or less, in spasmodic affections of the stomach, cholera, etc.

Elixir de Garus.

Take of	Syr. Adiantum (maidenhair) lb. ½ to Ov	Ox.
	Spirit of garus	Oviij.
	Saffron	℥j.
	Orange-flower water	Oss.

Macerate two days, and filter.

Spirit of Garus.

Take of	Aloes,	
	Saffron, each	℥vss.
	Myrrh,	
	Canella,	
	Cloves,	
	Cinnamon,	
	Nutmegs, of each, bruised	℥iv.
	Alcohol dilut.	Oxvj.
	Orange-flower water	Oj.

Macerate two days, and distil one gallon.

For other formulas for elixirs the reader is referred to *Am. Journ. Pharmacy*, pages 219, 298, 310, vol. xliii., for 1871, and the report on this subject to Am. Pharm. Association herewith appended.

The importance of uniformity in the composition of remedies bearing the same name has been so long felt and acknowledged by medical men and those interested in the advancement of pharmaceutic knowledge, that the American Pharmaceutical Association, at their twentieth annual meeting in Cleveland, Ohio, appointed a special committee to report such formulas, for elixirs particularly, as would be generally satisfactory and give a quasi officinal character to the formulas so reported; the great increase in the variety of elixirs made by so many different manufacturers, who give no information respecting the composition of their respective preparations, has rendered it almost impossible for any dispensing pharmacist to keep a complete stock of the various makes on his shelves. These considerations induced the committee to report the following formulas, which were ordered to be printed in pamphlet form as well as in their published proceedings.

UNOFFICINAL FORMULAS.

REPORTED BY J. F. HANCOCK.

Compound Powder of Cochineal.

Take of	Cochineal, in powder	120 grains.
	Alum, in powder	120 grains.
	Carbonate of potassium	120 grains.
	Bitartrate of potassium	240 grains.

Mix. Keep in well-stoppered vial.

Compound Tincture of Cochineal.

Take of Compound powder of cochineal . . . . . 120 grains.
Diluted alcohol . . . . . 2 fluidounces.

Slightly warm the diluted alcohol and mix with the powder, macerate in a stoppered vial for twelve hours, and filter for use. This is permanent, and imparts a beautiful red color to elixirs and solutions which have no acid properties.

Spirit of Orange.

Take of Oil of sweet orange . . . . . 1 fluidounce.
Stronger alcohol . . . . . 15 fluidounces.

Mix. This is made in proportions to conform with the spirits of the *U. S. P.*, and is a pleasant and convenient form of orange flavor.

Simple Elixir.

Take of Spirit of orange . . . . . ½ fluidounce.
Stronger alcohol . . . . . 4 fluidounces.
Cinnamon water . . . . . 6 fluidounces.
Syrup . . . . . 6 fluidounces.

Mix.

This is a turbid mixture. For many purposes it is not necessary to filter before using, but generally it should be clear, particularly when used for physicians' prescriptions, and in making some elixirs. Filtering-paper pulp, made by beating scraps of chemically pure filtering-paper in a mortar, in the proportion of sixty grains of paper to a half fluidounce of water, added to sixteen fluidounces of the elixir, agitated briskly for a few moments, and filtered, renders the elixir perfectly limpid. The paper is free from the chemical objections urged against carbonate of magnesium, chalk, etc., which are frequently used as clarifying agents.

The very pleasant taste and odor of this elixir, its freedom from color and chemical impurities, commend it for general use as a medicating vehicle.

Red Elixir.

Take of Comp. tincture of cochineal . . . . . ½ fluidounce.
Simple elixir . . . . . 16 fluidounces.

Mix.

This is sometimes preferred as a simple elixir because of its beautiful color.

Elixir of Calisaya Bark.

Take of Tincture cinchona, *U. S. P.* 1870 . . . 22 fluidrachms.
Simple elixir . . . . . Sufficient to make 16 fluidounces.

Mix and filter. This contains *the virtues* of two grains of Calisaya bark in one fluidrachm.

Elixir of Calisaya Bark with Iron.

Take of Elixir of Calisaya bark . . . . . 15 fluidounces.
Warm distilled water . . . . . 1 fluidounce.
Citrate of iron, *soluble* . . . . . 128 grains.

Dissolve the iron in the warm water and add the elixir. Filter if necessary. Each fluidrachm of the unfiltered elixir contains one grain of the iron salt, and the virtues of nearly two grains of Calisaya bark.

Compound Elixir of Cinchona.

Take of Compound tincture of cinchona, *U. S. P.* 1870 . . 22 fluidrachms.
Simple elixir . . . . . Sufficient to make 16 fluidounces.

Mix and filter. If not required for immediate use, this and also the Calisaya elixir should stand for about twelve hours before filtering.

Compound Elixir of Cinchona with Iron.

Take of Compound elixir of cinchona . . . . . 15 fluidounces.
Warm distilled water . . . . . 1 fluidounce.
Citrate of iron, *soluble* . . . . . 120 grains.

Mix. Proceed as for Elixir of Caliaysa with Iron.

Elixir of Citrate of Iron.

Take of Citrate of iron, *soluble* . . . . . 256 grains.
Warm distilled water . . . . . 1 fluidounce.
Simple elixir . . . . . 15 fluidounces.

Dissolve the iron in the warm water, and mix with the simple elixir. Filter.

Elixir of Pyrophosphate of Iron.

Take of Pyrophosphate of iron . . . . . 256 grains.
Warm distilled water . . . . . 1 fluidounce.
Simple elixir . . . . . 15 fluidounces.

Make according to directions for Elixir of Citrate of Iron.
This is the same in medicinal strength as Prof. Diehl's formula.

Elixir of Citrate of Bismuth.

Take of Citrate of bismuth and ammonium . . . 256 grains.
Warm distilled water . . . . . 4 fluidounces.
Water of ammonia (drop by drop) . . . Sufficient.
Simple elixir . . . . . Sufficient to make sixteen fluidounces of finished elixir.

This is the same bismuth strength as Prof. Diehl's formula, viz., two grains of citrate of bismuth and ammonium in each fluidrachm.

Elixir of Pepsin.

Take of Saccharated pepsin (Scheffer's formula) . 256 grains.
Sherry wine . . . . . 14 fluidounces.
Simple syrup . . . . . 2 fluidounces.
Fluid extract of ginger . . . . . 25 drops.

Dissolve the pepsin in the wine, mix the fluid extract of ginger with the syrup, and mix together. Filter if necessary. Contains two grains of pepsin to the fluidrachm.

Elixir of Valerianate of Ammonium.

Take of Valerianate of ammonium, in crystals . .	256 grains.
Compound tincture of cochineal	½ fluidounce.
Simple elixir	15½ fluidounces.

Dissolve the valerianate of ammonium in two ounces of the simple elixir, and carefully add water of ammonia until the solution is exactly neutral to test-paper. Mix with the balance of simple elixir, and then add the compound tincture of cochineal.

This is the formula of Prof. C. Lewis Diehl, with the exception of the simple elixir. Notwithstanding this preparation contains a larger quantity than usual of the valerianate of ammonium (two grains of the salt in each fluidrachm), yet its unpleasant taste and odor are effectually masked by the fragrance of the simple elixir.

Elixir of Valerianate of Ammonium with Quinia.

Take of Sulphate of quinia	128 grains.
Elixir of valerianate of ammonium . . .	16 fluidounces.

Mix. Filter if necessary. Sulphate of quinia is soluble in elixir of valerianate of ammonium to twice the quantity here ordered.

Compound Elixir of Sumbul.

Take of Tincture of sumbul (Brit. Ph. 1867)* . . .	4 fluidounces.
Syrup	4 fluidounces.
Compound tincture of cochineal	½ fluidounces.
Elixir of valerianate of ammonium	8 fluidounces.

Mix.

The elixir is slightly turbid, owing to the resin of the sumbul, which if filtered out must lessen its medicinal powers. This is given as a type of *extemporaneous elixirs*, which should not be filtered, but dispensed with the direction, "*Shake the vial before pouring out each dose.*"

Elixir Pyrophosphate of Iron, Quinia, and Strychnia.

(C. Lewis Diehl's Formula.)

He says: "This requires particular manipulation, which precludes the use of simple elixirs.

"The following formula, the result of concert experiments of my friend, Mr. E. Scheffer, and myself, has been used by me since autumn, 1869, and I can recommend it as uniformly successful, when the manipulations are carefully conducted:—

"Take of Sulphate of quinia	60 grains.
Strychnia	1 grain.
Citric acid	5 grains.
Stronger alcohol	3 fluidounces.
Spirit of orange	80 minims.
Syrup	6 fluidounces.
Pyrophosphate of iron	½ troyounces.
Distilled water	7 fluidounces.
Water of ammonia	Suff. quantity.

* This is made by macerating and displacing two and a half ounces avoirdupois of powdered sumbul with proof spirit so as to obtain one imperial pint (f℥xix f℥iss., U. S. measure) of tincture.—EDITOR.

"Triturate the sulphate of quinia, strychnia, and citric acid together, until minutely divided, then add the alcohol and spirit of orange. Warm the syrup slightly (to about 150° F.), and add to the turbid mixture, when, upon stirring, the mixture becomes clear. To this add the pyrophosphate of iron, previously dissolved in the distilled water, and finally, carefully add water of ammonia, drop by drop, until the elixir is perfectly neutral to test-paper; filter. The finished preparation has a greenish-yellow color, a pleasant flavor of orange, and is permanent."

Bitter Wine of Iron.

(James T. Shinn's Formula, slightly modified.)

We have had several years' experience with the following formula, and it has given entire satisfaction to prescriber, dispenser, and consumer.

Take of	Sulphate of cinchonia	45 grains.
	Sulphate of quinia	15 grains.
	Citric acid	60 grains.
	Citrate of iron, *soluble*	240 grains.
	Concentrated tinct. fresh sweet orange-peel	3 fluidounces.
	Distilled water	3 fluidounces.
	Sherry wine	8 fluidounces.
	Syrup	2 fluidounces.

Dissolve the sulphates and citric acid in two ounces of the water, and the iron in the remaining ounce of water; mix the two solutions, and add the other ingredients, previously well mixed together.

The only change from the original formula is in the kind and quantity of orange flavor, for which we claim an improvement. See *Proceedings of American Pharmaceutical Association*, 1864, p. 234.

Elixir of Gentian with Iron.

Take of	Extract of gentian	128 grains.
	Citrate of iron, *soluble*	128 grains.
	Distilled water	1 fluidounce.
	Simple elixir	15 fluidounces.

Dissolve the extract and iron in the water, *warmed*, and add the simple elixir; filter.

Elixir of Bromide of Potassium.

Take of	Bromide of potassium	640 grains.
	Red elixir	16 fluidounces.

Mix.

This contains five grains of the salt in each fluidrachm, and is given as a type. The red elixir does not seem to answer for the elixir bromide of calcium; caramel is a more suitable coloring substance for the calcium elixir. We prefer the simple elixir in this case, and to use no coloring substance.

Syrup of Liquorice Root.

Take of Select liquorice root, in moderately coarse powder	4 troyounces.
Diluted alcohol	Suff. quantity.
Sugar	12 troyounces.

Moisten and pack in a conical percolator; macerate for twelve hours, percolate to exhaustion. Place the tincture over a water-bath until reduced to ten fluidounces, filter, and then add the sugar; lastly, sufficient distilled water to make sixteen fluidounces of finished syrup.

The syrup of liquorice root, when carefully prepared, is more effectual and more convenient for masking the bitterness of quinia, than is the very popular "compound elixir of taraxacum," and being free from the stimulating influence of alcohol, which is present in the elixir, is well adapted for children. The proper proportions will be one grain of quinia (any salt of it) to the fluidrachm, and if those for whom quinia is ordered will take the precaution to chew a small quantity of liquorice root, previous to taking the quinia mixed with the syrup of liquorice, in the proportions here recommended, scarcely any bitterness will be observed. As a matter of course, acids mixed with quinia and liquorice syrup will immediately develop the bitter taste.

It has of late become fashionable to use glycerin as an antiseptic and solvent in elixirs, as well as other compounds of pharmacy, but our aversion to the general use of glycerin for internal administration, for various reasons, has prevented its introduction in our formulas.

The results of our investigations of liquid pepsin preparations will not warrant the introduction of more than the one formula, which is really a wine of pepsin, and has been found useful in many cases.

CHAPTER IX.

PREPARATIONS OF OPIUM.

These preparations assume an importance to the student not belonging to others, from the extensive use made of opium in almost every form of disease, and from the unusual number and variety of "Galenical" solutions made from it.

No student should neglect to study these especially and carefully, so as to be familiar with their relative degrees of activity, and their effects as modified by the menstrua employed. On this account I have devoted a separate chapter to their consideration.

Syllabus of Officinal Preparations of Opium, designed to facilitate their study.

Officinal name.	Composition and relative strength.	In f℥j.	Dose.
Tinct. opii camphorata (paregoric)	Opium ℥ss Camphor ℈j Benzoic acid ℥ss Oil of aniseed f℥ss Honey ℥j } to Oj dil. alc. 1 gr. in 272 ♏	1.76 grs.	f℥j to f℥ss
Tinct. opii (laudanum)	Opium ℥x to Oj = 1 gr. in 12.8 ♏	37.5 grs.	gtt. xxv
" opii deodorata	do. do.	do.	gtt. xx
" opii acetata	Opium ℥j Alcohol f℥iv Vinegar f℥vj } 1 gr. in 10 ♏	48 grs.	gtt. xx
Vinum opii (Sydenham's laud.)	Opium ℥ij Cinnamon Cloves, āā ℥j } to sherry, Oj, 1 gr. in 8 ♏	60 grs.	gtt. xx
Acetum opii (black drop)	Opium ℥v Nutmeg ℥j Saffron ℥ijss Sugar ℥viij } to Oij, 1 gr. in $6\frac{4}{10}$ ♏	75 grs.	gtt. v to x
Liquor morphiæ sulphatis	½ gr. morphia = ¾ gr. opium, to f℥j	8 grs.	f℥j

REMARKS ON THE FOREGOING.

It will be observed that the preparations are arranged in the syllabus in the order of their strength—the proportion of opium they contain.

Camphorated tincture of opium is one of the most familiar and universally used of medicines; its preparation is easy, by macerating the ingredients in a bottle; the honey may be omitted till toward the end of the seven days allotted for the maceration. The chief use of paregoric is for children, to whom it is given in doses varying according to the age of the child from ten drops to a teaspoonful. The adult dose is as stated in the table. It is used in *mistura glycyrrhizæ comp.*, and in numerous expectorant medicines. An enumeration of the cases in which it is employed would be out of place in this work—the variety of its components adapts it to fill numerous indications.

This tincture, in the *Pharmacopœia* of 1830, was directed to be made with a portion of extract of liquorice, which, as it gave it a dark color, resembling that of laudanum, was superseded in the three last editions by honey. It has a rich brown color, and a rather agreeable aromatic taste.

Laudanum is more used than any other preparation of opium. It is employed internally in small doses, combined with stimulants, and frequently repeated, to excite the nervous and arterial systems, as in the typhoid forms of disease. (*See* Prescriptions.) It is also used by itself or in combination to allay nervous irritation, and to promote sleep and relieve pain; for these purposes, it generally requires to be given in full doses, especially when the case is urgent. It is sometimes employed in cancerous and other very painful diseases, and in mania-a-potu, in doses of half a fluidrachm to one

fluidrachm (60 to 120 drops), and repeated. Camphor water and compound spirit of ether are much used with it in its more strictly anodyne and sedative applications. In nervous and spasmodic affections, it is given with other antispasmodic medicines, or by itself. To expectorant mixtures it is a very frequent addition, though the camphorated tincture is generally preferable in this instance. Combined with astringents and chalk, it is much used in the treatment of diarrhœa, dysentery, and cholera morbus, and is a frequent addition to *mistura cretæ*. For its diaphoretic effects, the best combinations contain an emetic, as wine of ipecac or of antimony, or frequently spirit of nitrous ether. It is often added to castor oil, to correct griping or excessive purging from its use.

Laudanum is much used in enemata, collyria, and in lotions of various kinds. In an enema it may be used in three times the quantity employed by the mouth, with a view to the same effect. In an eye-wash, wine of opium, or a solution of the aqueous extract, is preferred, as obviating the stimulant effects of the alcohol. It is frequently added to cataplasms or poultices.

Laudanum is made of deficient strength by some druggists, in order to sell it cheaply. If it has become turbid from the evaporation of a portion of alcohol, it is above standard strength, and should be filtered to free it from the precipitate, fatal results have occurred from neglect of this precaution.

Tinctura opii deodorata is a new officinal in the *Pharmacopœia* of 1860, it is made upon the principle, adopted by the manufacturers of the various elixirs of opium in vogue, of treating opium with water in preference to alcohol, so that the objectionable resinous and odorous principles are but sparingly taken up; in the new officinal process, the aqueous fluid extract obtained is directed to be shaken up with ether, for the complete removal of these, and the ether being rejected the whole is embodied into a fluid form with only sufficient alcohol to preserve it. The dose by drops, as stated, is less than that of laudanum, with which it corresponds in strength, because aqueous liquids collect in larger drops than alcoholic. On the whole, this liquid, which will probably be generally dispensed as *elixir of opium*, is a valuable addition to our officinal preparations, and well worthy the favorable consideration of physicians.

Acetated tincture of opium is not commonly designated by any synonym, and must be carefully distinguished from black drop, described below. It is prepared by macerating the opium in powder with the vinegar and alcohol for two weeks, or displacing as in the case of laudanum. If the opium is in mass, it should be used in proportionately increased quantity, and worked into a paste with a small portion of the vinegar, after which the remainder of that liquid and the alcohol is added, macerating for two weeks as in the other case.

This tincture is sometimes recommended in preference to laudanum, as less liable to produce those nervous symptoms which often follow the use of opium. As shown in the table, it is stronger than laudanum, but much weaker than black drop.

Wine of Opium.—This officinal substitute for Sydenham's laudanum may be made by a similar process to the foregoing. It is made with a much larger proportion of opium to the quantity of menstruum employed than laudanum, and yet the dose directed in the books is the same; this must be owing to a supposed inferior solubility of the active principles in wine, than in diluted alcohol. A great many extemporaneous prescriptions for eye-washes and injections contain this ingredient.

Vinegar of Opium, Black Drop.—The strongest of the preparations of opium is modified in the edition of the *Pharmacopœia* for 1860, so as to make it comparatively easy of preparation and of more convenient proportions. The very complex process of the older books is simplified so as to include merely the complete extraction of the opium and aromatics by means of diluted acetic acid, the addition to this of sugar, and its dilution to just the required point, which is a fluidounce for every 75 grains of opium used. The slight alteration in proportions, while it will be quite imperceptible in the use of the preparation, brings it to an even two pints for five troyounces of the opium used.

Black drop is deservedly esteemed as a most valuable preparation. The morphia it contains is in the condition of acetate; which is considered by many to be more agreeable in its mode of action than the native meconate existing in the drug. One grain of opium being represented by about $6\frac{4}{6}$ minims, the dose will be only from five to ten drops, because, although in the case of laudanum two drops are frequently required to make a minim, in this case, sugar being used instead of alcohol, the drops are larger, and frequently reach a minim in bulk.

The popularity of black drop with persons who use opium habitually is one of the strongest evidences of its superiority over laudanum. I was informed by one lady, who is a victim to this vice, and who procures her black drop by the gallon, that, in comparing her own condition with that of others within the range of her acquaintance who have used laudanum to no greater excess than she uses black drop, while they soon exhibited in their persons the evidences of its poisonous effects, she was enabled to preserve to a great extent the natural freshness and fulness of her features; this she attributed to the form in which she took the drug. Her statement cannot of course be received as evidence of the difference referred to, though it accords with the testimony of others, and also corresponds with the observation of some physicians of large experience.

Solution of sulphate of morphia (U. S.), though its strength is usually estimated somewhat above that stated in the syllabus, is believed to be weaker in proportion to the other preparations than is there stated.

Magendie's solution, much used in New York and Boston, is made in the proportion of sixteen grains to the fluidounce. Care should be taken, in prescribing and vending this, to distinguish between it and the officinal solution.

Incompatibles.—All the preparations of opium are pharmaceutically incompatible with the alkalies, and their mono-carbonates generally, on account of their precipitating the morphia in an insoluble condition from its meconate. With acetate of lead, they give a precipitate, chiefly of meconate of lead, the morphia remaining in solution as acetate. Astringent infusions and tinctures generally throw down tannates or gallates of morphia, which are quite insoluble. Some of the metallic salts may be considered as incompatible, but in practice there is no difficulty in mixing small quantities of laudanum with diluted solutions of these. The chief point to be observed, in the mixing of these preparations in prescription, is *to add them after the full degree of dilution is obtained;* in this manner they may be mixed without disturbance, in the great majority of instances, especially where, as is mostly the case, the quantity added is small.

Treatment of Poisoning by Opium.—When opium is taken in quantities sufficient to produce death, the first and invariable remedy is to evacuate the stomach, by administering an active emetic dose, as, for instance, five grains of tartar emetic or sulphate of zinc, or, as is frequently more convenient and equally efficacious, large doses of mustard suspended in warm water. If emetics refuse to act, which is sometimes the case after long delay, the stomach pump must be resorted to, and should always be at hand in the office of the physician. A tolerable substitute for this is found in the self-injecting apparatus of elastic gum, now so commonly in use, the tubes being transposed so as to reverse the direction of the current.

A mode of emptying the stomach of an infant, tried with success in a case of poisoning, by Dr. Stebbins, of Chester Co., Pa., is to insert a catheter and suck up the fluid contents till the catheter is full, then turn the free end downwards so as to constitute a siphon, from which the fluid will run till the stomach is empty.

The patient should be kept in motion, if possible, the face and head being splashed with cold water, when a disposition to sleep seems to be gaining the mastery; in this way, patients may very frequently be restored, even after taking large doses of laudanum. Instances of the kind have been of frequent occurrence within the last few years in this city. The recently discovered use of tincture of belladonna as an antidote for opium should not be forgotten when other resources fail, and when this remedy is at hand. The dose must necessarily be large, corresponding to the quantity of laudanum taken. In the case of young infants too deeply narcotized to swallow, subcutaneous injections of $\frac{1}{6}\frac{1}{4}$th of a grain of atropia may succeed in reviving the struggling vitality.

Two cases have come under my own notice, in which the galvanic battery has been employed as a last resort, with the effect of restoring one patient permanently, and the other temporarily, the reaction not being sufficient in the latter instance to establish convalescence, though life was prolonged for several weeks. Artificial respiration has occasionally been resorted to, when the prostrating influence of the poison had arrested the natural process, life being

prolonged by this means, until the impression of the narcotic had passed off; recovery has been effected in this way.

The Abuse of Opium.—The habitual use of the preparations of opium as a means of intoxication, is an evil, the extent of which is scarcely appreciated by the profession, or by the community at large. There are shops in the outskirts of our large cities in which the sale of laudanum forms one of the principal items of business. These peddle it out to every poor victim who can produce a few pennies to purchase a temporary relief from imaginary pains. So common is this article of trade that even little children are furnished with it on application, as if it were the most harmless drug. It is sold in these shops at half the price maintained by respectable establishments, and there can be no doubt that its intoxicating effects are sought by many, who use it as a substitute for alcoholic drinks. Individuals who would shrink from the habitual use of spirituous liquors employ this *medicine*, under a false persuasion that it is useful or necessary to allay some symptom of chronic disease, until they become victims to one of the worst of habits. There is scarcely an apothecary in our large cities who cannot relate instances of opium intoxication that have come under his own notice, and been served at his own counter. Females afflicted with chronic disease; widows bereft of their earthly support; inebriates who have abandoned the bottle; lovers disappointed in their hopes; flee to this powerful drug, either in its crude form, in the form of tincture, or some of its salts, to relieve their pain of body or mind, or to take the place of another repudiated stimulant. Such, too, is the morbid taste of these, that they think they require the soporific influence of opium to fill up the measure of their life enjoyment, just as the drunkard is wedded to his cups, or the tobacco-user to the weed.

The responsibility for many cases of habitual intoxication, both with alcohol and opium, undoubtedly rests with the physician. Almost every apothecary of large experience has met with instances in which the parties attribute their habit to the use of these agents, for the first time, under the advice of a physician, by whose direction it has been persisted in, in some chronic case, till it has become almost impossible to desist from the indulgence.

The quantity of laudanum that may be taken varies with different individuals. Those habituated to it consume from a few teaspoonfuls to an ounce or more per day. A medical friend informed me that a child less than two years old came under his observation, to whom was administered a dessertspoonful of laudanum per diem to keep it quiet, while the mother was engaged at her daily toil; this, of course, was the result of previous habit, originating in a small beginning.

Persons who have been addicted to the use of ardent spirits, are, perhaps, more apt to use laudanum in preference to the crude drug, or any of the salts of morphia. The cheapness of the tincture over the salts is a strong reason with others. We know of a lady whose bill for sulphate of morphia, during a single year, was ninety dol-

lars, which, if we estimate it at the usual price, and take the daily average of the quantity consumed, would exhibit the enormous consumption of over 20 grains a day. And yet the victim of this slavery is able to attend, in some measure, to her daily pursuits, and has already attained middle age, without any evidence of organic disease.

Another lady, suffering from a uterine complaint, who had been for years in the habit of using opium, at first by the advice of a physician and subsequently from an impression of its value to her, continued it in gradually increasing doses, till the daily consumption of the gum and the tincture, taken alternately, amounted to many grains of the former, and half an ounce of the latter. In this case the patient was bedridden, and suffered a great deal of pain when the system was not directly influenced by the medicine.

A degree of restlessness and nervous irritability, amounting almost to spasms, when not under the effects of the drug, are characteristic in almost every aggravated case.

One colored woman, advanced in life, who had been advised many years before, by her physician, to employ laudanum for the relief of the painful symptoms of a chronic disease, was known for several years to take invariably f℥iss of laudanum, which was purchased daily as required. A lady of my acquaintance, who I believe since recovered entirely from the habit, took for years a half grain powder of sulphate of morphia daily, sometimes perhaps twice a day. On one occasion a man proposed to purchase at the counter a fluidounce vial of laudanum, and when the price of it was demanded, immediately swallowed the whole, as was supposed for the purpose of suicide. He was afterwards seen in the streets apparently in his usual health.

Dr. Garrod relates a case of a young man who took one drachm of Smyrna opium night and morning, and frequently from an ounce to an ounce and a half of laudanum in addition.

We are informed of an instance of a lady advanced to her threescore years and ten, who, from fear of the pains of death, from day to day kept herself under the influence of this narcotic. Such was the morbid mental influence which kept her unhappy in the anticipation of a result which has not yet occurred.

The moral responsibility connected with the question of prescribing and dispensing opium, may be greater than has been hitherto acknowledged; and the few remarks here presented are designed to awaken an interest among those who by position and pursuits are best qualified to exercise a wholesome influence upon its abuse.

Who would sell an ounce of laudanum to an applicant whose intention to commit suicide was apparent? And yet how often it is sold to individuals, who are only protracting their suicide by the demoralizing and dissipating habit of taking it in smaller and gradually increasing quantities.

Working Formulas for the Preparations of Opium.

Tinctura Opii Camphorata. (*Camphorated Tincture of Opium.*) U.S.P.

Paregoric Elixir.

Take of Opium, dried, and in moderately fine powder,
Benzoic acid, each, sixty grains.
Camphor, forty grains.
Oil of anise, a fluidrachm.
Clarified honey, two troyounces.
Diluted alcohol, two pints.

Macerate for seven days, and filter through paper. (It is well to omit the honey till near the close of the maceration.)

Tinctura Opii. (*Tincture of Opium.*) U. S. P.

Laudanum.

Take of Opium, dried, and in moderately fine powder, two troyounces and a half.
Water,
Alcohol, each, a pint.
Diluted alcohol, a sufficient quantity.

Macerate the opium with the water for three days, with frequent agitation; then add the alcohol, and continue the maceration for three days longer. Introduce the mixture into a percolator, and, when the liquid has ceased to pass, pour diluted alcohol upon it until two pints of tincture are obtained.

All the preparations of opium are directed to be made from the powdered drug; this is designed to prevent variations in strength, resulting from the different degrees of dryness of different specimens, as found in commerce. In many instances, however, the apothecary or physician prefers to select the drug in its crude condition, and in the absence of conveniences for drying and powdering it in large quantities, uses it in lump. In this case the following process may be observed, the necessary increase of weight in the opium being added, on account of the moisture it contains:—

Modified Formula for Laudanum.

Take of opium, sliced, two troyounces and six drachms, add to it four fluidounces of hot water, and by the aid of a pestle and mortar, work it into a uniform pasty mass; to this add twelve fluidounces of water, and a pint of alcohol, making in all two pints of diluted alcohol; allow it to macerate for two weeks, occasionally shaking it, and throw the whole upon a filter—to the pulp, remaining after the liquid has drained off, add about two fluidounces of diluted alcohol, which will displace the last portion so as to make the whole of the tincture measure exactly two pints.

Tinctura Opii Deodorata. (*Deodorized Tincture of Opium.*) U. S. P.

Take of Opium, dried, and in moderately fine powder, two troyounces and a half.
Ether,
Alcohol, each, half a pint.
Water, a sufficient quantity.

Macerate the opium with half a pint of water for twenty-four hours, and express; then repeat the operation twice with the same quantity of water. Mix the expressed liquids, and, having evaporated the mixture to four fluidounces, shake it when cold, in a bottle, repeatedly with the ether. Pour off the ethereal solution when it has separated by standing, and evaporate the remaining liquid until all traces of ether have disappeared. Mix this with twenty fluidounces of water, and filter the mixture through paper. When the liquid has ceased to pass, add sufficient water, through the filter, to make the filtered liquid measure a pint and a half. Lastly, add the alcohol, and mix them together.

If the opium is not dried and powdered, the manipulation may be varied, using two troyounces and six drachms of moist opium as indicated in the modified formula for laudanum.

In both this formula and the one preceding, it should be remembered that a very moist opium will lose more than ten per cent. of water, and the only accurate method of making the preparations of opium from the unpowdered drug is to take a piece of the opium, say 100 grains, after it has been well kneaded to make it uniform, and flatten it out into a thin cake, and dry it at a temperature of 120° till it no longer loses weight. From this experiment the proper allowance can be readily ascertained.

Tinctura Opii Acetata. (*Acetated Tincture of Opium.*) U. S. P.

Take of Opium, dried, and in moderately fine powder, two troyounces.
Vinegar, twelve fluidounces.
Alcohol, half a pint.

Rub the opium with the vinegar; then add the alcohol, and having macerated for seven days, express, and filter through paper.

Vinum Opii. (*Wine of Opium.*) U. S. P.

Take of Opium, dried, and in moderately fine powder, two troyounces.
Cinnamon, in moderately fine powder,
Cloves, in moderately fine powder, each, sixty grains.
Sherry wine, a sufficient quantity.

Mix the powders with fifteen fluidounces of sherry wine, and macerate for seven days, with occasional agitation; then transfer the mixture to a conical percolator, and, when the liquid has passed the surface, gradually pour on sherry wine until a pint of filtered liquid is obtained.

Acetum Opii. (*Vinegar of Opium.*)

Black Drop.

Take of Opium, dried, and in moderately coarse powder, five troyounces.
Nutmeg, in moderately coarse powder, a troyounce.
Saffron, in moderately coarse powder, one hundred and fifty grains.
Sugar, eight troyounces.
Diluted acetic acid, a sufficient quantity.

Macerate the opium, nutmeg, and saffron with a pint of diluted acetic acid for twenty-four hours. Put the mixture into a conical

glass percolator, and return the liquid which first passes until the filtrate becomes clear. Then gradually pour on diluted acetic acid until the filtered liquid measures twenty-six fluidounces. In this dissolve the sugar, and having strained the solution, add sufficient diluted acetic acid to make the whole measure two pints.

CHAPTER X.

EVAPORATION.

THIS process is employed in the preparation of most of the extracts, fluid extracts, and syrups, and in the concentration of solutions generally.

When the liquid under treatment is brought to its boiling point, so that the formation of vapor is upon the inner surface of the containing vessel, whence it escapes by its elasticity through the body of the liquid in bubbles, the process is termed *ebullition;* but when the liquid does not reach its boiling point, and the temperature and other circumstances are such that it is liberated in the form of vapor without disturbance, directly from the surface exposed to the air, it is termed *evaporation.*

Viewed as processes for dissipating the volatile ingredients, these differ chiefly in regard to the degree of heat employed, and the consequent rapidity with which the object is attained; in ebullition, the rapidity of the conversion of the liquid into vapor is in proportion to the extent of surface of the containing vessel exposed to the *fire*, while in evaporation it depends principally upon the extent of surface of the liquid exposed to the air.

The effect of reducing the temperature below the boiling point is exhibited by the following ascertained rates of evaporation: at 212° F. the rate of evaporation may be represented as 1, at 180° F. as $\frac{1}{2}$, at 150° F. as $\frac{1}{4}$, at 125° F. as $\frac{1}{8}$, at 100° F. as $\frac{1}{16}$, at 79° F. as $\frac{1}{32}$.

In evaporating saline solutions reference should be had to the presence or absence of volatile constituents, or the liability to decomposition at elevated temperatures, but as a general rule the most rapid evaporation is preferable.

For reasons pointed out in the last chapter, evaporation at a temperature below the boiling point is generally preferred for extracts. Many vegetable solutions, which would be greatly deteriorated by the long boiling necessary to reduce them to the condition of extracts, may be exposed to a temperature below their boiling point in a wide and shallow vessel until sufficiently inspissated, with little danger of losing their solubility or their medicinal activity.

Extracts are therefore to be evaporated in shallow vessels, which should be of porcelain or well-tinned iron or copper. Fig. 229 represents an ordinary evaporating dish of Berlin ware, which is the best material.

Fig. 229.

The long exposure of vegetable solutions to a moderate heat, besides being tedious, is liable to the objection in certain cases of exposing the proximate constituents for too long a period to the oxidizing influence of the air, sometimes allowing of the acetous fermentation.

The liquid to be evaporated should preferably be divided into smaller portions, and each reduced separately till highly concentrated: then these may be mixed. By this means, no one portion is long kept under the unfavorable circumstances of an elevated temperature and exposure to the air.

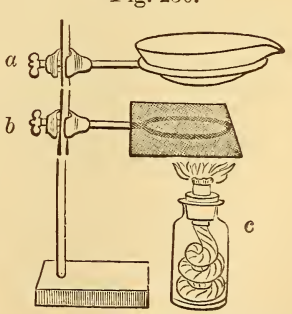
In many preparations, particularly the fluid extracts and some syrups, the process is directed to be carried to a certain point indicated by the *quantity* of the concentrated liquid. To facilitate the determination of this without removing the liquid from the evaporating dish, two methods are resorted to: the dish may be tared and from time to time placed upon the balance until it reaches the required weight previously ascertained, or a suitable slip of wood is previously marked with a notch at the point reached by the required quantity of liquid, and this being inserted perpendicularly in the liquid will indicate the point to arrest the evaporation.

Air at a certain temperature is capable of taking up a certain portion of vapor which is constant at that temperature, and evaporation ceases when the point of saturation is attained, therefore a draught greatly facilitates evaporation by carrying off the air as fast as it becomes charged with moisture, and constantly furnishing a dry atmosphere to become saturated in turn with the escaping vapor. Constant stirring, by continually exposing a large surface of the heated liquid to the air, also increases the rapidity of evaporation.

The different modes of applying heat for the purposes of evaporation, are: 1st. Directly by exposing the containing vessel to the source of heat. 2d. By a sand-bath. 3d. By a water-bath. 4th. By a steam-bath.

Whenever a vegetable solution is evaporated by a direct application of heat, it should be at such an elevation from the furnace or lamp, as not to be touched by the flame, so that the heat should be communicated only by radiation. When the heat is under perfect control, as in a gas furnace, and the process is watched, this plan may be substituted for the use of a water-bath with the advantage of the liquid being raised to the boiling point or depressed below it at pleasure.

Fig. 230.



Application of radiated heat.

Fig. 230 shows an arrangement for the direct application of radiated heat in evaporation; *a* is a diaphragm of wire

gauze placed between the evaporating dish *b* and the source of heat *c*, which spreads the flame and prevents its contact with the dish, though brought closely together; the diaphragm *a* may be omitted in using a gas furnace, as the flame is then under control by regulating the jet.

Several retort stands have been shown in the last chapter and in that on displacement, and the instrument as commonly constructed is sufficiently familar. In the ordinary kind, it is necessary in adjusting apparatus, or when it is desirable to disconnect or alter the position of the rings for any purpose, to slide them up the whole length of the rod, and remove all above them, which is sometimes a great inconvenience. In Wiegand's improvement, the casting that clasps the rod is open on one side to the diameter of the rod, so that by loosening the screw it may be slipped off laterally, and yet, when the screw is tightened so as to press firmly against the rod, it is sufficiently secure to bear any weight appropriate to such an apparatus. Fig. 231 gives a view of one of these separated from the rod, and in Fig. 230 the whole retort stand is shown in use, giving a front view of the improved clasp.

Fig. 231.

Wiegand's improved clasp for retort stand.

The sand-bath is seldom employed in the preparation of extracts, possessing no advantages over the carefully regulated direct application of radiated heat. The water-bath is directed in all the officinal processes, for the preparation of extracts; its advantages are detailed in Chapter III. Whatever means may be resorted to for effecting the concentration of vegetable solutions, with a view to the preparation of extracts, they should be finally evaporated to the proper consistence with great care, and a water-bath furnishes a means of controlling the temperature, especially adapted to unskilful and inexperienced persons.

The steam-bath is the most eligible means of applying heat for the purposes under discussion, although it is confined to the few who manufacture pharmaceutical preparations on a large scale. One difference between a steam-bath and a water-bath consists in the facility of the application of pressure to the steam in the one case and not in the other. The temperature of steam, as already stated, bears a remarkable relation to the pressure under which it is maintained; steam under pressure of five pounds to the square inch is at a temperature of 226°, which is about as high as can be safely employed in making extracts; as the liquid will boil at this temperature, of course the evaporation is more rapid than ordinary surface evaporation, and yet the containing vessel is not so hot as in ordinary cases of the direct application of heat. The fact that the temperature of steam under pressure is liable to the objection of injuring the vegetable principles in solution has induced a modification of the steam-bath so as to give it more the character of a water-bath, though with the advantages of conducting and communicating heat, which apply so peculiarly to steam.

A desirable apparatus is a hemispherical iron basin, perforated by a pipe through which the steam is introduced, and another for the exit of the condensed water into a waste pipe. The steam-pipe communicates with the boiler in which steam is generated for all the processes in the establishment, and several steam-baths stand out in the room, in convenient positions, and are adapted by rings of various diameters to any of the vessels in which it is desirable to conduct the several evaporations.

Fig. 232.

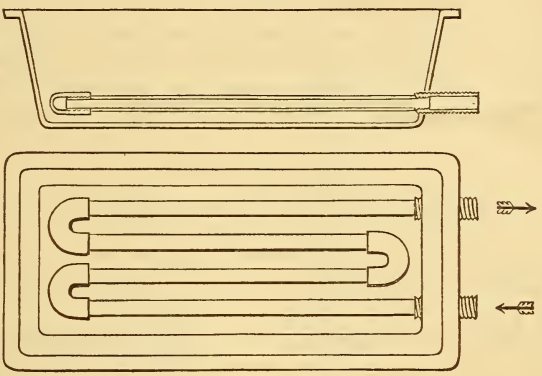


Fig. 232 shows an apparatus constructed from an ordinary galvanized iron sink and gas-pipe, which furnishes an extended evaporating surface; the pipe is three-fourths of an inch in diameter, and arranged horizontally in folds, the ends of the pipe being introduced through holes of appropriate size drilled in the end of the vessel, and well coated when the apparatus is galvanized. The vessel may be partially filled with sand, on which beakers, flasks, and other apparatus may rest, or they may be placed directly on the coil of pipe; or, should it be desired, a current of cold water can be turned into it and the coil when attached to a still be used as a condenser.

In the preparation of extracts by the use of steam, the pressure is so regulated that, as the solution becomes inspissated, the degree of heat can be diminished. Near the conclusion of the process the extract is sometimes withdrawn, and poured in thin layers on plates of glass, which are placed in a drying-room or closet, and subjected to a current of warm and dry air, till sufficiently hard.

The most perfect form of apparatus for the preparation of extracts, is a combination of the steam-bath with a vacuum pan. A suitable air-tight boiler is connected with an air-pump worked by machinery, which, by removing the pressure of the atmosphere from the liquid placed in it, lowers the boiling point, and greatly increases the rapidity of evaporation, even at a temperature of 120° to 140° F. The air being excluded, the principal objection to the long continued evaporation of vegetable solutions is also removed. In the

absence of facilities for evaporation in vacuo, the advantage of apparatus for distillation in concentrating vegetable juices and infusions should not be overlooked. The head of the still becoming full of steam excludes the air for the most part, and the condensation of the steam in the cooler brings about a partial vacuum which favors rapid evaporation.

In most establishments for the manufacture of extracts, vacuum pans, heated by steam, are employed for their concentration, and their products are generally considered to furnish proof of the superiority of this mode of evaporation over that accomplished under ordinary circumstances of pressure and exposure to the air; this is especially the case with those constituting *the first group* in the classification adopted in this work, which is primarily according to therapeutical properties, though the different modes of preparation are included in the arrangement of the groups.

Extracta, U. S. P.

1st Group.—Narcotic. Inspissated juices. From the fresh plant by expression, coagulation of the albumen, straining, and evaporation.

Officinal name.	Dose.	Medical properties.
Extractum belladonnæ	1 to 2 grains	*See* 2d Group, Alcoholic Extracts.
" conii	2 to 3 grains	Added to alterative compounds.
" hyoscyami	" "	Laxative, narcotic.

REMARKS.

The three extracts classed above form a remarkably natural group, therapeutically, pharmaceutically, and physically; as commonly prepared and imported, they have a more or less decidedly green color, and this feature was formerly regarded as a test of their having been prepared without scorching from the employment of too high heat; but, on the other hand, the green coloring principle (chlorophyll) is associated with the inert and insoluble vegetable albumen, which sometimes exists to the amount of from 12 to 18 per cent., and which the *U. S. Pharmacopœia* directs shall be first coagulated and separated; the strictly officinal extracts prepared by inspissating the juice of the green herbs, being deprived of this, have a brown color, and are nearly soluble in water. An article answering this description is sold under the name of clarified extracts.

The odor of extracts is one of the surest indications of their quality; it should, as nearly as possible, resemble that of the undried plant.

Extracts which are made by the use of vacuum apparatus and clarified are stronger than the kind made by ordinary evaporation; the doses stated in the books are above those usually prescribed. Great inconvenience results from a physician's ordering too large doses of clarified extracts, under a wrong impression as to the strength of the best commercial article.

The United States is largely supplied with this class of extracts

from England, where the herbs from which they are prepared appear to come to great prefection, but of the English manufacturers, of whom Squire, Allen, Herring, and Ransom have a high reputation, none adopt the method of clarification which is required by the *Pharmacopœia* of the United States.

The following table of the yield of extracts and inspissated juices is compiled from *Squire's Companion to the British Pharmacopœia*:—

Leaves. Fresh.	Leaves. Dry.	Officinal name.	Auth'y.	Leaves.
		Extract aconite	Ph. Br.	100 lbs. = 50 lbs. juice = 7 lbs. extract.
100 lbs.	= 16 lbs.	" belladonna	"	100 lbs. = 56 lbs. " = 4 lbs. "
100 lbs.	= 21 lbs.	" conii	"	100 lbs. = 50 lbs. " = 5½ lbs. "
		" " alcoholic	.....	100 lbs. (dry) 21 lbs. extract.
100 lbs.	= 15½ lbs.	" hyoscyami	Ph. Br.	100 lbs. = 50 lbs. juice = 5 lbs. extract.
		" quassia	.....	48 oz. (wood) = 1 oz. extract. 16 " " = 7 drms. extract.
		" arnica	.....	100 lbs. (flowers) = 33 lbs. juice.
		" digitalis, alc.	U. S.	100 lbs. = 27 per cent.
		" colocynth	.....	100 lbs. = 15 to 20 lbs.
		" gentianæ	U. S.	100 lbs. = 50 per cent. ext. by decoct.
		" nucis vomicæ	.....	100 lbs. = 7½ lbs. extract.
		" stramonium (leaves)	.....	100 lbs. = 3 lbs. inspissated juice.
		" stramonium (seed)	.....	100 lbs. = 13½ lbs. extract.
		" jalapa	.....	100 lbs. = 50 lbs. "

The *British Pharmacopœia* directs to heat the juice to 130°, strain to preserve the green coloring matter, then heat to 200° to coagulate the albumen, and filter again, evaporate to thin syrupy consistence, then add the green coloring matter, and evaporate, assiduously stirring, at a temperature not exceeding 140°. The *U. S. Pharmacopœia* directs the juice to be heated to the boiling point, strained, and evaporated to proper consistence.

Extract of belladonna is useful externally and internally as an anodyne in neuralgia, tic douloureux, and other painful affections, and as an antispasmodic in whooping-cough, and as a prophylactic in scarlet fever. It is much used in the treatment of diseases of the eye, and especially for the dilatation of the pupil before operations for cataract; for this purpose the extract is softened with water to the consistence of a thick liquid, and applied directly to the eyeball and painted on the upper and lower lids, a few hours before the operation. The fresh leaves yield about 5 per cent. of this extract.

Extract of stramonium, though no longer officinal, is usually prepared from the whole herb, which yields about 18 per cent. of extract. (*Gray.*) It is the least employed of the group. Besides the uses to which the others are applied, this has been prescribed in spasmodic asthma. The ointment made from the extract is a popular remedy in piles.

Extract of conium, on account of the volatility of its active prin-

ciple, is one of the most difficult of the extracts to prepare and preserve. It is employed in the treatment of glandular enlargement, scrofula, rheumatism, etc., as an alterative and anodyne, entering into the composition of numerous empirical preparations, besides being prescribed in regular practice. The whole plant is usually employed in its preparation, though the *Pharmacopœia* indicates the leaves as the officinal portion; the yield is about 3 to 5 per cent.

It should have a strong and characteristic odor, and is readily tested by the following experiment: Take a small pellet of the extract, soften it into a thin paste with water, and add a drop of solution of potassa, or of carbonate of potassium; immediately a strong characteristic odor will be observed, resembling, when faint, the odor of mice. This is from the liberation in a gaseous form of *conia*, the active principle of the herb, and on holding near it a rod moistened with muriatic acid, a copious cloud of muriate of conia will be produced.

If the extract is very inferior, the experiment will not succeed, or will be only partially successful. A cloud of muriate of ammonia without the mouse-like odor will be perceived.

Extract of hyoscyamus is the most extensively used internally of the series. The yield of the plant is about 5½ per cent. of extract. Its tendency to increase the secretions and to promote the action of the bowels renders it a particularly useful anodyne remedy.

Mohr's Process.—Prof. F. Mohr, starting from the fact that the activity of narcotic herbs belongs to principles which are soluble in both alcohol and water, proposed a method for preparing such extracts, the main features of which have been adopted by the *Pharmacopœias* of the different German States. It is the following: The fresh herb is expressed, mixed with about one-seventh of its weight of water, again expressed, the liquid raised to near the boiling point, and strained from the precipitated albumen, which has coagulated and thrown down the chlorophyll; it is then evaporated at from 120° to 130° F. to one-fourth the weight of the original material, mixed with an equal bulk of alcohol to separate gum and mucilage, strained, and with constant stirring evaporated to the proper consistence. This process furnishes very strong and reliable extracts; they are not so variable as those obtained by the inspissation of the juices, which vary according to the locality and the season. The only principles here extracted are active, and the dose is correspondingly small. None of our manufacturers have as yet put this process in practice, though some of the best German pharmacists in the United States import these excellent extracts. It is, however, worthy of remark that inferior, almost worthless, extracts are manufactured in Germany for the American market.

2d Group.—Narcotics, etc., alcoholic. Extracted by alcohol and diluted alcohol, and evaporated.

Officinal name.	Dose.	Medical properties.
Extractum aconiti	½ gr. to 1 gr.	Nervous sedative.
" belladonnæ alcoholicum	"	Narcotic.
" stramonii	"	"
" conii alcoholicum	1 to 2 grs.	Alterative, narcotic.
" hyoscyami alcoholicum	"	Laxative, narcotic.
" digitalis	¼ gr. to ½ gr.	Art. sedative, diuretic.
" cannabis Americanæ	½ gr. to 2 grs.	Intoxicant (variable).
" " Indicæ	"	" "
" valerianæ	3 to 5 grs.	Antispasmodic.
" Arnicæ		In arnica plaster.
" nncis vomicæ	½ gr. to 1 gr.	Tonic, excito-motor
" ignatiæ	"	" "
" physostigma	$\frac{1}{10}$ gr. to ¼ gr.	" "

REMARKS.

The use of an alcoholic menstruum for the extraction of the dried herbs possesses some advantages, in the preparation of extracts, over the inspissation of the juices of the fresh plants as obtained by expression. The albuminous matter, not being soluble in alcohol, is not present in the solution, and after evaporation the active principles constitute a much larger proportion of the resulting extract; hence the doses of the narcotic extracts are much smaller than of those of the first group. They are also much more easily prepared by the pharmacist on a small scale than the inspissated juices; by the use of apparatus at hand in almost every shop the members of this group can be satisfactorily prepared, the only practical difficulty being the supply of fresh and reliable herbs. Those imported from England at high prices are the only commercial variety of these leaves to be depended on, except in the case of stramonium, which may be collected in abundance in the outskirts of almost any town. The modes of extraction and evaporation of this group are varied in almost every instance; in the case of aconite, conium, digitalis, and valerian, a limited quantity of strong alcohol is first passed through the powdered mass; the first percolate is set aside to evaporate spontaneously, and the extraction being then finished with diluted alcohol, and this evaporated on a water-bath, it is, toward the last, incorporated with the reserved portion, and the whole brought to the proper consistence. Alcoholic extracts of belladonna, of hyoscyamus, of stramonium, and of arnica, are made by the inspissation, without reserving any portion for spontaneous evaporation, of a tincture made with two parts of alcohol to one of water.

Alcoholic extracts of nux vomica and ignatia are obtained by inspissating tinctures of the powdered drug made with strong alcohol; they are very powerful remedies, and possess a resinous consistence, becoming dry and brittle by age.

The extract of cannabis indica, as obtained from the East Indies,

often contains much insoluble and inert matter which in the above purified extract is separated by solution, filtration, and evaporation. This method, however, is less practised than the direct preparation by digestion or steam percolation of an alcoholic extract from the carefully dried imported herb. I have not met with the East India extract in our markets for a long time, and have been in the habit of dispensing the best English extract prepared from the Gunjah itself.

This process is now directed by the *U. S. Pharmacopœia*. The tests most to be relied upon for extract cannabis are its solubility in alcohol, ether, chloroform, benzine, and oil of turpentine, peculiar odor when moderately heated, indifference to alkalies, and the behavior towards HNO_3 (specific gravity 1.38), by which an orange-red resinoid substance like gamboge is produced.

The therapeutical applications of these extracts are numerous, though the inspissated juices of *belladonna*, *stramonium*, *conium*, and *hyoscyamus*, as included in the first group, are much more used. The alcoholic extracts are best adapted to incorporation with ointments and plasters, from their containing less inert insoluble matter, also for reducing to a dry and pulverulent condition, where this is necessary, as for prescriptions in the form of powder. In the absence of an inspissated juice of *aconite*, formerly officinal, the alcoholic extract should have an opportunity of a fair trial, and in view of its importance as a powerful internal remedy in neuralgic affections and in fevers, and its great utility in the form of plaster, as well as the smallness of its dose for internal use, it will doubtless find a place in many prescriptions. An alcoholic extract of aconite root would probably be an improvement on that of the leaves for most external applications. Alcoholic extract of *arnica* is for the first time made officinal in the *Pharmacopœia* of 1860, its use being in the fabrication of arnica plaster. An opportunity is now furnished for the trial of this remedy internally in the form of pill and for the settlement of its therapeutical position. *Extract of valerian* was for the first time introduced into our national standard in the revision of 1860; the formula is a good one, and as it furnishes an opportunity for prescribing this esteemed antispasmodic in a less offensive form than the tincture or fluid extract, it will doubtless gain favor with physicians and patients.

Extract of digitalis should have been, long since, in the *U. S. Pharmacopœia;* it has been in common use for many years. In view of the perishable nature of the powdered leaves, it is adapted to supersede these in extemporaneous combination.

Extract of cannabis is one of the most useful of the class of narcotic remedies, but for its great uncertainty of operation. Some specimens produce the most powerful and even alarming symptoms in doses of a single grain or even less, while others require 5 or even 10 grains to produce its characteristic results. Its peculiarities as a remedy consist in its producing none of those depressing effects generally characteristic of narcotics; it does not affect the pulse or the appetite, nor is it apt to cause sleep except by allaying

nervous symptoms. It is equally applicable to acute inflammatory and to typhoid affections.

Alcoholic extracts of nux vomica and ignatia are two of the most powerful tonics within the reach of the practitioner, they are usually prescribed along with other bitters and sometimes with the mineral tonics; it should be remembered that they contain strychnia and brucia, two powerful vegetable alkalies, and that they are cumulative in their effects and liable to produce tetanic symptoms, on the least appearance of which the use of the remedy should be arrested. The commercial extract of nux vomica is often given in one-grain doses, but it is frequently much below standard strength.

Extract Physostigmatis, U. S. P.—This is made by displacing with alcohol until exhausted, after four days' maceration of the powder, in a conical percolator. The alcohol should be recovered by distillation, and the remainder should be evaporated by water-bath to the consistence of soft extract.

3d Group.—Cathartics, tonics, etc., alcoholic. Extracted by alcohol and water, or by diluted alcohol.

Officinal name.	Dose.	Medical properties.
Extractum jalapæ	10 to 15 grs.	Cathartic.
" podophylli	5 to 10 grs.	do.
" hellebori alcoholicum	10 to 15 grs.	Emmenagogue, cathartic.
" rhei "	do.	Cathartic.
" colocynthidis* "		do.
" dulcamaræ	3 to 6 grs.	Alterative, narcotic.
" senegæ	1 to 3 grs.	Stimulant, expectorant.
" cinchonæ†	10 to 15 grs.	Tonic.

REMARKS.

In preparing the above important preparations there are various modifications of the process of extraction by diluted alcohol and subsequent evaporation. This process in its simplest form is adopted in the case of colocynth, dulcamara, and senega, in the former of which maceration and strong expression precede percolation. In treating cinchona, jalap, and podophyllum, the alcohol and water are applied successively and the percolates separately evaporated to the consistence of thin honey, mixed and further concentrated to the proper consistence. Rhubarb and black hellebore are instances in which the percolation is, first with strong alcohol, followed by diluted alcohol; the first percolate being evaporated spontaneously, and the other by a water-bath, till they reach the consistence of syrup; they are then directed to be mixed and further concentrated to the consistence of an extract.

Of the above cathartics, each has its peculiar properties, adapting it to some peculiar use.

* *See* Extractum Colocynthidis Compositum.
† *See* Extractum Calisayicum.

Extract of hellebore is used as an emmenagogue cathartic. In combination with aloes, myrrh, sulphate of iron, etc., it constitutes the celebrated Hooper's Female Pills.

Extract of jalap is combined with compound extract of colocynth, calomel, and gamboge in the compound cathartic pill; it is, perhaps, seldom prepared of standard quality, and is especially liable to sophistication and adulteration.

Extract of podophyllum is less used than it deserves, being equal to extract of jalap in its cathartic effect in half the dose. Podophyllin is a more concentrated and, for many uses, a more convenient preparation, but it is not so perfect a representative of the root as this extract. In the opinion of Dr. Wood this extract might be substituted for extract of jalap in all cases.

Extract of rhubarb is rarely employed by practitioners in the United States, though it offers facilities for using this valuable tonic cathartic in larger doses in the form of pill than the powdered root itself.

Extract of cinchona is seldom used in practice in this country. This extract of cinchona must not be confounded with the article called Wetherill's Extract, nor with extractum calisayicum, which are superior preparations, treated of among the unofficinal extracts.

Extract of dulcamara has been removed into this group from the group of aqueous extracts in which it was formerly included; it is but little prescribed, though doubtless an admirable vehicle for other alterative medicines in the form of pill.

Extract of seneka is a new officinal for which there seems to me to be little use, as seneka root, being an expectorant, is seldom required in the pilular form, and its syrup and decoction are favorably known as liquid preparations.

Extract of colocynth is introduced into the *Pharmacopœia* with a view to the ready preparation of the compound extract, which is a well-known and popular remedy; its properties adapt it to being dried and powdered. It may be advantageously prescribed as an active cathartic in many combinations. Extract of colocynth should be made of the medullary part deprived of the seed, which constitutes from 25 to 34 per cent. of the drug; the extract yielded after maceration is about 60 per cent., and is dry and resinous.

4TH GROUP.—Tonics, astringents, etc. Extracted by water and evaporated.

Officinal name.	Med. dose.	Remarks.
Extractum gentianæ	10 to 20 grs.	Tonic.
" quassiæ	3 to 6 grs.	do.
" krameriæ (rhatany)	10 to 20 grs.	Astringent.
" hæmatoxyli	do.	do.
" juglandis (butternut)	do.	Cathartic.
" opii	½ grain	Narcotic.

REMARKS.

Extracts of gentian, quassia, and butternut are made by precisely the same process, involving percolation with cold water, boiling down to three-fourths, straining, and evaporating. Extract of rhatany differs from this by being raised to the boiling point merely, strained, and evaporated on a water-bath, a variation made necessary by the proneness of the astringent principle to become insoluble and inert by long exposure to a boiling temperature. Logwood, on the contrary, is extracted by long boiling, and on evaporation becomes dry and pulverulent, a property which it shares with most of the astringent extracts. Opium is sliced and triturated with water to obtain its soluble principles, requiring repeated macerations and filtrations; it forms then a perfectly smooth, uniform, and soluble extract by careful evaporation.

The great advantage of *extract of quassia* over *extract of gentian* in making pills, will be seen by comparing the doses. *Extract of rhatany*, when well prepared, so as to be soluble in water, is a valuable substitute for kino and catechu, which it resembles in physical as well as medical properties. It differs in medical properties from *extract of logwood*, though both are astringents; the last named is more mild in its action, and is especially adapted to relaxed conditions of the bowels. Extract of logwood is also largely used in dyeing, and in the manufacture of writing fluids. It is important, in selecting rhatany root, to obtain that which has the most bark attached to it. Prof. Procter, in a comparative assay of the bark and wood, found the former to yield 33 per cent., while the latter gave only 6.8 per cent. A very great yield of extract is obtained when the root is decocted, but nearly one-half of it is insoluble. Long exposure to the air should be avoided, as it occasions an insoluble apotheme. If the extract is purchased it is well to test its solubility in cold water.

Extract of butternut, or white walnut, is a mild alterative, laxative, and diuretic medicine, but little prescribed, but well worthy the attention of practitioners in the treatment of chronic diseases.

Aqueous extract of opium is a most useful preparation, much used in eye-washes and astringent injections, and well adapted to replace opium itself in pill masses and for other internal uses; the proximate principles of opium, soluble in water, are those most agreeable in their action.

Unclassified Extracts.

Extractum taraxaci	Dose ʒj	By inspissating the expressed juice, diuretic, cholagogue.
" colchici acet.	Dose 1 to 2 grs.	Extracted by diluted acetic acid, sedative.
" colocynthidis comp.	Dose 10 grs.	Cathartic mixed powders.

Extract of taraxacum is a most useful, though mild, remedy adapted to a large class of chronic cases. Much that is met with in the market is quite deficient in the bitterness characteristic of a

good article; it is also apt to ferment or become mouldy from deficient evaporation. The evaporation should be pushed till the pilular consistence is fully attained.

Acetic extract of colchicum is an invaluable remedy in rheumatic and gouty affections, and in a variety of combinations indicated under the head of Extemporaneous Prescriptions is largely prescribed.

Compound extract of colocynth is a most valuable remedy, for which an entirely new formula is given in the *Pharmacopœia* of 1860, found among the working formulas which follow. It is an exception to the extracts generally in being kept in powder.

Working Formulas of Extracts, including some not found in the Pharmacopœia.

SECOND GROUP.

Extractum Digitalis Alcohilicum, U. S. P.

Take of Digitalis, recently dried and in fine powder, twelve troyounces.
Alcohol, a pint.
Diluted alcohol, a sufficient quantity.

Introduce the powder, previously mixed with one-third of the alcohol, into a percolator, and pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour diluted alcohol upon it until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of tincture have passed, or until the powder is exhausted; then evaporate this liquid, by means of a water-bath, at a temperature not exceeding 160°, to the consistence of syrup. To this add the three fluidounces of tincture first obtained, and continue the evaporation, at a temperature not exceeding 120°, until the whole is reduced to the proper consistence.

By the same process prepare—

Extractum Conii Alcoholicum, U. S. P.

From conium leaves, recently dried and in fine powder.

Extractum Stramonii Foliorum, U. S. P.

From stramonium leaves, recently dried and in fine powder.

Extractum Valerianæ Alcoholicum, U. S. P.

From valerian, in fine powder.

Extractum Aconiti, U. S. P.

From aconite leaves, recently dried and in fine powder.

Extractum Belladonnæ Alcoholicum, U. S. P.

Take of Belladonna leaves, in fine powder, twenty-four troyounces.
Alcohol, four pints.
Water, two pints.
Diluted alcohol, a sufficient quantity.

Mix the alcohol and water, and moisten the powder with a pint of the mixture; then pack it firmly in a conical percolator, and gradually pour upon it the remainder of the mixture. Continue the percolation with diluted alcohol until six pints of tincture have passed. Lastly, evaporate this, by means of a water-bath, to the proper consistence.

By the same process prepare—

Extractum Hyoscyami Alcoholicum, U. S. P.

From hyoscyamus leaves, recently dried and in moderately fine powder.

Extractum Arnicæ, U. S. P.

From arnica, in moderately coarse powder.

Extractum Nucis Vomicæ, U. S. P.

Take of Nux vomica, in fine powder, twelve troyounces.
Alcohol, a sufficient quantity.

Mix the nux vomica with four fluidounces of alcohol, and allow the mixture to stand for an hour. Then introduce it into a cylindrical percolator, and gradually pour alcohol upon it until the tincture passes without bitterness. Distil off the alcohol, by means of a water-bath, until the tincture is reduced to half a pint, and evaporate this to the proper consistence.

By the same process prepare—

Extractum Ignatiæ Alcoholicum, U. S. P.

From ignatia, in fine powder.

Extractum Cannabis Americanæ. (*Extract of American Hemp.*) U. S. P.

Take of American hemp, in moderately fine powder . . . . ℥xij.
Alcohol, a sufficient quantity.

Moisten the hemp with six fluidounces of alcohol, pack it in a conical percolator, cover the surface with a disk of paper, and pour on six fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork and cover the percolator closely, let it stand four days, then percolate with alcohol till exhausted and evaporate by means of a water-bath.

Extractum Cannabis Indicæ. (*Extract of Hemp.*) U. S. P.

Take of Indian hemp, in moderately fine powder . . . . . ℥xij.
Alcohol, a sufficient quantity.

Moisten the hemp with six fluidounces of alcohol, pack it in a conical percolator, cover the surface with a disk of paper, and pour

on six fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, to prevent the evaporation, set it aside in a moderately warm place for four days. Then, having removed the cork, gradually pour alcohol upon the surface until two pints of tincture have been obtained, or until the hemp is exhausted. Lastly, by means of a water-bath, evaporate to a proper consistence.

THIRD GROUP.

Extractum Colocynthidis Alcoholicum, U. S. P.

Take of Colocynth, forty-eight troyounces.
Diluted alcohol, a sufficient quantity.

Dry the colocynth, and, having removed the seeds and reduced it to a coarse powder by grinding or bruising, macerate it in eight pints of diluted alcohol for four days, with occasional stirring; then express strongly, and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and pour diluted alcohol upon it until the tincture and expressed liquid, taken together, measure sixteen pints. Mix the tincture with the expressed liquid, and, having recovered from the mixture ten pints of alcohol by distillation, evaporate the residue to dryness by means of a water-bath. Lastly, reduce the dry mass to powder, and keep it in a well-stopped bottle.

The extract obtained by this process weighs about seven troyounces.

Extractum Dulcamaræ, U. S. P.

Take of Bittersweet, in moderately fine powder, twelve troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the bittersweet with four fluidounces of diluted alcohol, pack it in a conical percolator and pour diluted alcohol gradually upon it until the tincture passes but slightly imbued with the properties of the bittersweet. Distil off the alcohol from the tincture until reduced to one-half; then strain, and by means of a water-bath evaporate to the proper consistence.

Extractum Senegæ, U. S. P.

Prepare from seneka in moderately fine powder by the above process, omitting to strain the liquid when reduced to one-half.

Extractum Jalapæ. (*Extract of Jalap.*) U. S. P.

Take of Jalap, in moderately fine powder, twelve troyounces.
Alcohol, four pints.
Water, a sufficient quantity.

Introduce the powder, previously mixed with three fluidounces of alcohol, into a conical percolator, and gradually pour upon it the remainder of the alcohol. When the liquid ceases to pass, pour upon the residue sufficient water to keep its surface covered, until four pints of tincture have passed. Set this aside, and continue

the percolation until six pints of infusion have been obtained. Distil off the alcohol from the tincture, and evaporate the infusion until the liquids respectively have been brought to the consistence of thin honey; then mix them and evaporate to the proper consistence.

By the same process prepare—

Extractum Cinchonæ,* U. S. P.

From yellow cinchona, in fine powder.

Extractum Podophylli, U. S. P.

From May apple, in moderately fine powder.

Extractum Hellebori, U. S. P.

Take of Black hellebore, recently dried and in fine powder, twelve troyounces.
Alcohol, a pint.
Diluted alcohol, a sufficient quantity.

Introduce the powder, previously mixed with one-third of the alcohol, into a conical percolator, and pour upon it the remainder of the alcohol. When the liquid has all been absorbed by the powder, pour on diluted alcohol until a pint of tincture has been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to three fluidounces. Continue the percolation with diluted alcohol until two pints more of the tincture have passed or until the powder is exhausted; then evaporate, by means of a water-bath, at a temperature not exceeding 160°, to the consistence of syrup. To this add the three fluidounces of tincture first obtained, and continue the evaporation, at a temperature not exceeding 120°, until the whole is reduced to the proper consistence.

Extractum Rhei. (*Extract of Rhubarb.*) U. S. P.

Extractum Rhei, Phar. 1850.

Take of Rhubarb, in moderately fine powder, twelve troyounces.
Alcohol, a pint.
Diluted alcohol, a sufficient quantity.

Moisten the powder with four fluidounces of the alcohol, pack it in a conical percolator, and gradually pour upon it, first the remainder of the alcohol, and afterwards diluted alcohol, until twelve fluidounces of tincture have been obtained. Set this aside in a warm place, and allow it to evaporate spontaneously until reduced to six fluidounces. Continue the percolation with diluted alcohol until the tincture passes nearly tasteless. Evaporate this in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 160°, to the consistence of syrup. With this mix the tincture first obtained, and continue the evaporation until the mixture is reduced to the proper consistence.

* See Extractum Calisayicum.

FOURTH GROUP.

Extractum Gentianæ, U. S. P.

Take of Gentian, in moderately coarse powder, twelve troyounces.
Water, a sufficient quantity.

Moisten the gentian with four fluidounces of water, pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly impregnated with the properties of the gentian. Boil the liquid to three-fourths of its bulk; then strain, and by means of a water-bath evaporate to the proper consistence.

By the same process prepare—

Extractum Quassiæ, U. S. P.

From Quassia, in moderately fine powder.

Extractum Juglandis, U. S. P.

From Butternut (bark), in moderately coarse powder.

Extractum Krameriæ. (*Extract of Rhatany.*) U. S. P.

Take of Rhatany, in moderately fine powder, twelve troyounces.
Water, a sufficient quantity.

Moisten the powder with four fluidounces of water, pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly impregnated with the astringent property of the rhatany. Heat the liquid to the boiling point, strain, and, by means of a water-bath, at a temperature not exceeding 160°, evaporate to the proper consistence.

Extractum Hæmatoxyli. (*Extract of Logwood.*) U. S. P.

Take of Logwood, rasped, twelve troyounces.
Water, eight pints.

Boil down to four pints, and strain the decoction while hot, then evaporate to dryness.

Extractum Opii. (*Extract of Opium.*) U. S. P.

Take of Opium, twelve troyounces.
Water, five pints.

Cut the opium into small pieces, macerate it for twenty-four hours in a pint of the water, and reduce it to a soft mass by trituration. Express the liquid, and treat the residue with each of the four remaining pints of water successively in the same manner. Having mixed the liquids, filter the mixture, and evaporate by means of a water-bath to the proper consistence.

Unclassified.

Extractum Taraxaci,* U. S. P.

Take of Dandelion, gathered in September, sixty troyounces.

Slice the dandelion, and bruise it in a stone mortar, sprinkling on it a little water, until reduced to a pulp. Then express and strain the juice, and evaporate it in a vacuum, or in a shallow dish over a water-bath, to the proper consistence.

Extractum Colchici Aceticum, U. S. P. (*Acetic Extract of Colchium.*)

Take of Colchicum root, in moderately fine powder, twelve troyounces.
Acetic acid, four fluidounces.
Water, a sufficient quantity.

To the acetic acid add a pint of water, and mix the resulting liquid with the colchicum root. Transfer the mixture to a conical glass percolator, and pour water gradually upon it until the liquid passes with little or no taste. Lastly evaporate the liquid, in a porcelain vesssel, to the proper consistence.

Extractum Colocynthidis Compositum. (*Comp. Ext. of Colocynth.*) U. S. P.

Take of Alcoholic extract of colocynth, in fine powder, three troyounces and a half.
Purified aloes, in fine powder, twelve troyounces.
Resin of scammony, in fine powder, three troyounces.
Cardamom, in fine powder, a troyounce.
Soap, in fine powder, three troyounces.

Mix the powders thoroughly, and keep the mixture in a well-stopped bottle.

Unofficinal Extracts.

Of the extracts not recognized in the *U. S. Pharmacopœia*, described in former editions of this work, several have been introduced into the last edition of our national standard; without wishing to add unnecessarily to the numerous preparations already introduced, the following are deemed of sufficient importance to claim the attention of the student and practitioner:—

Calisaya Extract (Ellis).—Is made by boiling coarsely-powdered Calisaya bark in successive portions of water acidulated with muriatic acid, precipitating the decoction with hydrate of lime, digesting the precipitate in hot alcohol till all taste is exhausted, and then evaporating the alcohol so as to leave an extract. The old-fashioned precipitated extract of bark was nearly identical with this, which is only objectionable on the score of expense.

It contains all the quinia and cinchonia contained in the bark, besides the amorphous quinia, or chinoidine, and is an admirable substitute for the celebrated "Wetherill's extract," formerly much in vogue. Its dose is from 2 to 5 grs.—*Am. Journ. Pharm.*, vol. xx. p. 15.

* See Fluid Extract of Taraxacum for process for preserving the root for expression and evaporation.

Chinoidine is the name given to an insoluble residuary extractive principle obtained in the manufacture of quinia, which is described under the head of Vegetable Alkalies.

Extractum Lobeliæ Aceticum.—To prepare this, the powdered seeds of lobelia are macerated, and then displaced with diluted alcohol, to the first portion of which has been added a small portion of acetic acid. This liquid is then to be evaporated to the consistence of an extract, which will be about one-eighth the quantity of the seed employed. (*Am. Journ. Pharm.*, vol. xiv. p. 108.) DOSE, from 2 to 3 grs. The object of the use of the acetic acid is to form a soluble acetate of lobelina, less readily decomposable by heat than the native salt.

Extract of Lupulin.—Take of lupulin half a troyounce, alcohol half a pint. Mix in a percolator and allow it to stand an hour, then displace with alcohol until two pints are obtained, or the whole strength extracted; pour this into a shallow dish in a warm place, and allow it to evaporate spontaneously to the consistence of an extract; ʒj of lupulin yields about ℈ij of the extract, which is proposed as a substitute for the powder when prescribed in the pilular form. The dose is from 3 to 6 grains; it is recommended by its utility as a convenient and adhesive excipient for other substances. The reputation lupulin has obtained as an antaphrodisiac in irritable conditions of the gential organs, calls for convenient preparations by which the physician is enabled to make choice of the several forms of extemporaneous prescription. The new officinal fluid extract seems less eligible for most purposes than a solid extract such as this, proposed some years since by my late pupil, W. W. D. Livermore. The empirical preparation prescribed under the name of "lupulin" by the Eclectics, is probably nearly identical with this.

Extractum Cimicifugæ.—This extract is made by evaporating separately a tincture prepared with alcohol of 95 per cent. and one made with diluted alcohol, until they reach a syrupy consistence, then mixing these and finishing the evaporation over a water-bath, with constant stirring.

This process is liable, in the case of cimicifuga, which is a very resinous root, to a serious objection. Even after the extract has been completed, a partial separation of the resinous ingredient is liable to occur, producing great variations in quality between different portions of the same lot of extract. Prof. J. F. Moore, of Baltimore, recommends that the tincture made with strong alcohol should be first evaporated to dryness, powdered, and incorporated with the other portion just before it is removed from the fire. The dose of this extract is 5 grains; it represents all the constituents of the root more thoroughly than the *resinoid cimicifugin*, and is worthy a trial in the anomalous cases of nervous disorder which so often tax the resources of the physician. Much that is sold is prepared from the root after the separation of the cimicifugin.

Extractum Pareiræ is prepared from sliced pareira brava, by decoction with water, straining, and evaporating. A decoction is more

frequently prescribed; but this extract allows the practitioner a choice of the pilular form, in which combinations with various other remedies may be conveniently prescribed. Dose, from 10 to 30 grs.

Extractum Uvæ Ursi.—The London College directs the preparation of this, also, by maceration and decoction with water. Its dose is the same as the foregoing, and they are both used as tonics and diuretics in chronic urinary disorders.

Ergotine.—Under this name an extract of ergot is sold in the shops, for which the following is the formula of M. Bonjean:—

Exhaust powdered ergot by displacement with cold water, heat the solution in a water-bath, and filter; evaporate to the consistence of syrup, and add rectified spirit to throw down the gummy matter; when settled, decant the clear liquid, and evaporate by water-bath. One ounce of ergot yields about 70 grains. It is said to possess the hæmostatic without the toxic effects of ergot. Dose, from 4 to 10 grs.

The ergotine of *Wiggers* consists chiefly of resinous principles, and is insoluble in water.

The *extracts of lettuce, poppy-heads, and hops* are very weak narcotic extracts, occasionally prescribed, but less esteemed than lactucarium, opium, and lupuline, which are the more efficient products of their respective plants.

Extractum glycyrrhizæ is the name given in the list of the *Pharmacopœia* to the common drug known as liquorice, imported from Italy and Spain. Until recently this was the only extract of liquorice used; our manufacturers now make a true and proper extract, which is made in either of two ways, as follows:—

1*st Process.*—Take of liquorice root, bruised, any convenient quantity, macerate in water, with the application of heat, until exhausted; strain, and evaporate to the consistence of an extract.

2*d Process.*—Take of liquorice (impure extract) any convenient quantity, lay the pieces of liquorice in a large displacer, or a barrel, in layers alternating with straw; macerate, and then percolate the mass with cold water, and evaporate the clear liquid that runs off. The pieces of liquorice will be found to have lost their saccharine matter, glycyrrhizin, although retaining their shape as before. This is officinal in some European *Pharmacopœias*, under the name of Extractum s. succus liquoritæ depur, and is valued particularly on account of its perfect solubility in water. A large proportion of glycyrrhizin is left behind in a modified state, and may be gained by exhausting the residue with a very dilute ammonia, which renders it soluble.

The extract has a yellow color, becoming brown by age, and as made by the first process has the taste of the root, and is deliquescent, so as to require to be kept in jars. One part of powdered liquorice root to sixteen of the extract will render it firm enough to keep in sticks. Tilden's extract of liquorice is made into sticks of a yellowish-brown color by admixture with gum Arabic; its taste resembles the root more decidedly than that of black liquorice.

Physical Properties.

The *physical properties of extracts* vary, according to their composition, age, and the circumstances in which they are kept.

The narcotic extracts of the first class, as vended by the manufacturers, are apt to be too soft for convenient use in the form of pills, and are disposed to deliquesce. This want of a firm consistence, which results from a disposition to preserve the more volatile ingredients from loss in the final concentration, causes no inconvenience when the extract is used with a considerable proportion of dry or hard ingredients. It may be obviated by combining with them powdered liquorice root or marsh mallow, when the additional bulk is no objection. The alcoholic and hydro-alcoholic extracts are seldom liable to this objection; they harden on exposure to the air, and when old are sometimes inconveniently dry.

The extracts of jalap and podophyllum are apt to become tough and unmanageable, so as to resist the action of the pestle either by trituration or contusion. Extract of jalap is ordered, in compound cathartic pills, in the form of powder, and this is in some respects its best form for use; it is conveniently kept in bottles, as other powders are, is readily weighed and incorporated with other substances, and becomes plastic by the addition of moisture. Few manufacturers push the evaporation so far as to produce the extract dry enough for powdering; but there is no difficulty in accomplishing it in dry and frosty weather where steam is employed, and as a demand grows up for the article it will be more generally met with in the stores, although at a somewhat advanced price on the soft extract. Compound extract of colocynth is frequently brittle enough to powder, and is now directed in the *Pharmacopœia* in this form. The addition of soap to its other ingredients prevents the liability to toughness, besides increasing its solubility.

Extracts of rhatany and of logwood are always pulverulent, and when properly made are nearly soluble in water.

The kind of jars usually employed for preserving extracts are figured in the chapter on the outfit of the physician's office. Those with covers or tops are most eligible. In furnishing a shop where a good many are needed, it is well to reserve the canopy-top jars exclusively for ointments, the flat tops for extracts, for the sake of distinction. Extracts should never be put in gallipots or tie-overs, except for temporary purposes. Besides the cover, which fits loosely on the jars, there should be a piece of bladder, or tinfoil, or paper saturated with oil, wax, paraffine, or soluble glass, or parchment paper which may be made after the common paper has been marked with the name and quantity of the extract. (*See* Lignin.) Upon covered jars these impervious coverings should be stretched over the open top before fitting on the lid.

In the case of soft extracts, which have a tendency to mould, the occasional addition of a few drops of alcohol is found advantageous; wide-mouth bottles, either with ground stoppers or corks, are preferable to jars as affording a more complete exclusion of the air, but

the smaller sized bottles, having too narrow mouths to admit a spatula of ordinary width, are inconvenient.

The Uses of Extracts.—This class of preparations may be used either in the form of pill, solution, or mixture. They are chiefly prescribed in the pilular form, combined with other substances, and to this they are peculiarly adapted. One of the chief points in making pills is to increase or modify the effect in the highest degree, without a corresponding increase of bulk. Hence the utility of adding extracts to substances possessing no adhesiveness, choosing among them such as will most promote the therapeutic effect, while a plastic mass will be the result. Thus, in tonic pills, as of subcarbonate of iron or sulphate of quinia, extract of quassia or of gentian would be preferable to an inert substance like conserve of rose or mucilage.

In dilute aqueous solutions, extracts are not generally preferable to the corresponding tincture or fluid extracts, but where the dose of the tincture would be large, the physician often avails himself of the extract in preference, as not containing alcoholic stimulus. Extracts are generally combined in *mixtures* containing sweet or viscid substances more than in *solutions* proper, although in cases where the quantity of the extract desired is large, and it is soluble in water, it may be employed to impart viscidity to a mixture, and to suspend insoluble substances without the necessity of using either gum or sugar.

It will greatly facilitate the dispensing of extracts prescribed in ointments, to have a small jar containing the extract softened by working into it half its weight of glycerin, and using one and a half drachm of such an extract instead of one drachm.

In triturating an extract, particularly a hard one, with viscid liquids, as syrup or mucilage, or with lard in making ointments, considerable difficulty is experienced in dissolving or diffusing it equally throughout the mixture; to obviate this, it should be first softened with a few drops of water if aqueous, or alcohol if alcoholic, until it has about the consistence of thick honey or treacle, and then incorporated with the other ingredients. Frequently it will require a long and tedious trituration to accomplish the object thoroughly and effectually.

The most effectual and unobjectionable method of softening extracts for the purpose of incorporating them with other substances or making mixtures, is to place (if aqueous) a small quantity of water in the jar with the extract and place the jar in a close vessel of boiling water; the combined effect of heat and moisture will produce the desired result quite rapidly.

The aid of heat will greatly facilitate the softening of extracts, especially in making pill masses, which become dryer and more firm when rendered plastic by heat than when softened by a moist excipient.

CHAPTER XI.

FLUID EXTRACTS AND OLEORESINS.

The class *Extracta fluida* is found for the first time in the *Pharmacopœia* in the edition of 1850. Most of those at that time made officinal had been used and were esteemed standard remedies for several years previously, though two of them (oleoresins) have never attained popularity.

During the ten years immediately preceding the edition of 1860, the number of this class had greatly extended, and we have at present twenty-five officinal preparations under this head, besides several formerly classed with them, now named *oleoresins*. Of this number fifteen are alcoholic solutions, and may be defined as concentrated tinctures, although some of them, as fluid extract of taraxacum, are preserved by a minimum of the alcoholic menstruum; the other ten are concentrated syrups, some of which are less highly charged with the saccharine ingredient than would be necessary in the absence of alcohol, a sufficient proportion of which is retained in the solution to prevent decomposition.

In making fluid extracts it is often impracticable to dissolve the large proportion of sugar necessary to prevent fermentation without rendering the fluid extract too thick to be conveniently poured from a bottle or spoon, and yet the form of syrup is especially adapted to those which are administered in large doses or are given chiefly to children. The Committee of Revision have shown great judgment in the framing of these formulas, and it is to be hoped that the officinal fluid extracts will supersede those made by various manufacturers according to their own arbitrary standards, and the precise composition of which has not been made public.

The original idea of a fluid extract was to make it represent an equal portion of the drug, every troyounce weight of the material from which prepared being converted into a fluidounce of the fluid extract. The result of this, if carried out, would be to simplify the recollection of the doses of fluid extracts by stating the dose in each case to be the same as of the drug. This rule was departed from, even in the *Pharmacopœia* of 1850, and the unofficinal formulas published have in many instances been quite independent of any uniform rule of strength.

Among the fluid extracts made officinal in 1860, there are only two which form exceptions to this rule, the fluid extracts of cinchona and of wild cherry; in both these instances, good reasons existed for reducing the strength from the usual standard.

Alcohol, from its eminently useful qualities as a solvent for active vegetable principles, and from its perfect adaptability to percola-

tion, and the low temperature at which it evaporates, is invariably selected as the menstruum used in the process of extraction; in the case of conium, ergot, and ipecacuanha, the first two of which contain volatile organic alkalies, while the last named owes its activity to a vegetable alkali not readily separable from associated inert principles, acetic or muriatic acid is added to bring the natural bases to the condition of soluble and more permanent acetates or chlorides.

Within a few years past, the views expressed first by Mr. A. B. Taylor, regarding glycerin as an appropriate substance to be used to supply the place of part of the sugar used in some fluid extracts, have been amply confirmed, and its use greatly increased, even to adopting it as a partial menstruum for a number of this class of preparations.

The officinal directions of the last edition of the *Pharmacopœia* for preparing fluid extracts require, that, unless otherwise ordered, the powder be moistened with a specified quantity of menstruum and properly packed in a suitable percolator. The surface of the liquid is then to be covered with a disk of paper, and the remaining portion of the sixteen fluidounces of menstruum is to be poured upon it. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator to prevent evaporation, set it aside in a moderately warm place for four days. The cork is then to be removed, more menstruum is to be gradually poured on, and the percolation to be continued until twenty-four fluidounces have been obtained. Of these the first fourteen fluidounces are to be reserved, and the remainder, having been carefully evaporated to two fluidounces, is to be mixed with the reserved portion, and filtered through paper if necessary.

Syllabus of Officinal Fluid Extracts.

1st Group.—Concentrated tinctures with diluted alcohol.

Officinal name.	Dose.	Medical properties.
Extract. cimifugæ fluid.	♏ xv to xx	Tonic nervous sedative.
" valerianæ "	♏ xxx	Tonic antispasmodic.
" veratri viridis fluid.	♏ v to x	Arterial sedative.
" lupulina	♏ v to x	Antaphrodisiac.
" cubebæ	♏ xx	Diuretic and stimulant.
" mezerei	♏ ij to iv and for cerate	Alterative.
" sabina	External use in cerate	Stimulant.

REMARKS ON GROUP FIRST.

The several articles here grouped are directed to be exhausted with stronger alcohol (.817 sp. gr.), their peculiar composition being such that a menstruum of this strength most completely removes the active principles, and at the same time, the excess of menstruum is most easily removed without recourse to undue elevation of temperature; it will be noticed, that the present officinal directions authorize only twenty-four fluidounces of percolate

to be obtained, and the first fourteen to be kept as a reserve, and not exposed to either heat or atmospheric influence, while the remaing ten fluidounces are to be carefully evaporated to two fluidounces, which when added to the reserved tincture yield the required quantity.

Extracta Fluida.

2d Group.—Concentrated tinctures with alcohol.

Officinal name.	Doses for adults.	Medical properties.
Extract. buchu fluidum	♏ xx	Diuretic and stimulant.
" serpentariæ fluidum	♏ v to x	Tonic, stimulant.
" zingiberis "	♏ v to xx	Aromatic, stimulant, and carminative.
" erigirontis canadensis fluidum	♏ v to x	Antihemorrhagic, tonic, and astring.
" gelsemii fluidum	♏ ij to v	Arterial sedative.

REMARKS ON GROUP SECOND.

These extracts are directed to be made with alcohol (.835 sp. gr.) and are to be made in accordance with the general directions already given, there being no exceptions in this class; the volatile oil and resin contained in each drug being readily removed by the menstruum directed. When prescribed in mixtures their resinous character must be remembered, and some vehicle selected, which will prevent the deposition of resin and separation of the volatile oil.

Extracta Fluida, *U. S.*

3d Group.—Concentrated tinctures with glycerin and diluted alcohol.

Officinal name.	Dose.	Medical properties.
Extract. belladonnæ radic. fluidum	♏ j to ij (1—2 min.)	Narcotic.
" conii fructus "	♏ ij to iv	" alterative.
" hyoscyami "	♏ v to xv	" laxative.
" digitalis "	♏ j to ij	Diuretic, arterial, sedative.
" colchici rad. "	♏ ij to vj	Sedative and cathartic.
" " semi. "	♏ ii to vj	" " "
" cinchonæ "	♏ x to xxx	Tonic and antiperiodic.
" cornus floridæ "	♏ x to xx	"
" gentianæ "	♏ x to xxx	"
" chimaphilæ "	♏ x to xx	" astringent, diuretic.
" uva ursi "	♏ xx to lx	" "
" pareiræ brava "	♏ x to xx	" " diuretic.
" geranii "	♏ x to xx	Astringent.
" krameriæ "	♏ v to xx	"
" rubi "	♏ v to x	"
" ergotæ "	♏ xx to xxx	Parturient and emmenagogue.
" gossypii "	♏ x to xx	" " "
" dulcamaræ "	ʒj to ʒij	Feebly narcot. and diaphoretic.
" stillingiæ "	♏ xxx to ʒj	Alterative.
" matico "	♏ xx to xxx	Stimulant, aromatic.
" glycyrrhizæ rad. "	ʒj to ʒss	Demulcent.
" senegæ "	♏ x to xx	Expectorant and emetic.
" taraxaci "	ʒj to ʒij	Diuretic, tonic, and aperient.
" sarsaparillæ "	ʒss to ʒiv	Alterative.
" " comp. "	ʒss to ʒi	"
" columbæ "	ʒss to ʒj	Tonic.
" hydrastis "	♏ iij to v	"
" rhei "	♏ x to xx	Cathartic and astringent.
" scillæ "	♏ v to xx	Emetic, expect, and diuretic.

REMARKS ON GROUP THIRD.

This is by far the largest class of fluid extracts; from being second in number in the last edition of this work, and regarded in the light of concentrated syrups, it has, by the introduction of glycerin, been changed to glycerinated tinctures, and rendered in many instances much more desirable, both in a pharmaceutic and therapeutic point of view. The strength of cinchona extract, it will be observed, has now been made troyounce to fluidounce. The proportion of glycerin to the pint is four fluidounces, excepting in the case of the six last named on the list, in two of which, sarsaparilla and sarsaparilla compound, half a pint is contained, in the other four but two fluidounces being directed. The general alcoholic strength is the same, except in a few instances, which will be noticed in the working formulas appended.

Extracta Fluida, *U. S.*

Unclassified. Principally glycerinated tinctures.

Officinal name.	Dose.	Medical properties.
Extract. ipecacuanhæ fluidum	♏ ij to xx	Emetic, expectorant.
" pruni virginianæ "	f℥ss to f℥j	Tonic, sedative, expectorant.
" sennæ "	f℥ss to ℥j	Cathartic.
" spigeliæ "	℥ij to ℥ss	Anthelmintic.
" " et sennæ "	f℥ij to f℥ss	" and purgative.

REMARKS UPON THE UNCLASSIFED FLUID EXTRACTS.

These vary in the quantities of glycerin directed, and the strengths of the alcohol employed. Thus, in the formulas for fluid extracts of ipecacuanha, prunus virginianus, and spigelia, each has half a pint of glycerin, and ipecacuanha and prunus each requires stronger alcohol, while extracts of senna and spigelia require alcohol .835.

The extract of ipecacuanha made by this process has been found objectionably thick, and for this reason much objected to, while fluid extract of rhubarb is improved when compared with the semi-fluid extract of older editions of the *Pharmacopœia.*

Working Formulas for Officinal Fluid Extracts.

(Alphabetically arranged.)

Extractum Belladonna Radicis Fluidum. Fluid Extract of Belladonna Root.

Take of Belladonna root, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the belladonna root with four fluidounces of the mixture, proceed according to the general formula given in a former part of this chapter. Finish

the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Buchu Fluidum, U. S. P.

Take of Buchu, in moderately fine powder, sixteen troyounces.
Alcohol, a sufficient quantity.

Moisten the buchu with six fluidounces of alcohol, and proceed according to the general formula given for fluid extracts in a former part of this chapter.

Extractum Calumbæ Fluidum, U. S. P.

Take of Columbo, in fine powder, sixteen troyounces.
Glycerin, f℥ij.
Alcohol,
Water, each, a sufficient quantity.

Mix fourteen fluidounces of alcohol with the glycerin, and, having moistened the powder with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with a menstruum consisting of two parts of alcohol and one part of water.

Extractum Chimaphilæ Fluidum, U. S. P.

Take of Pipsissewa, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five of water, and, having moistened the pipsissewa with half a pint of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Cimicifugæ Fluidum, U. S. P.

Take of Cimicifuga, in fine powder, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the cimicifuga with four fluidounces of the stronger alcohol, and proceed according to the general formula for fluid extracts.

Extractum Cinchonæ Fluidum, U. S. P.

Take of Yellow cinchona, in very fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the cinchona with five fluidounces of the mixture, proceed according to the general

formula for fluid extracts. Continue the percolation with diluted alcohol, until two pints of percolate have been obtained, and having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Colchici Radicis Fluidum, U. S. P.

Take of Colchicum root, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the colchicum root with five fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Colchici Seminis Fluidum, U. S. P.

Take of Colchicum seed, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the colchicum seed with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Conii Fructûs Fluidum. · (*Fluid Extract of Conium Seed.*) U. S. P.

Take of Conium seed, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Muriatic acid, one hundred and eighty grains.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the conium seed with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add the muriatic acid and one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Cornus Floridæ Fluidum, U. S. P.

Take of Dogwood, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the dogwood with five fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Cubebæ Fluidum, U. S. P.

Take of Cubeb, in moderately fine powder, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the cubeb with six fluidounces of stronger alcohol, and proceed according to the general formula for fluid extracts.

Extractum Digitalis Fluidum, U. S. P.

Take of Digitalis, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and having moistened the digitalis with half a pint of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Dulcamaræ Fluidum, U. S. P.

Take of Bittersweet, in moderately coarse powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the bittersweet with six fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Ergotæ Fluidum, U. S. P.

Take of Ergot, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Acetic acid, half a fluidounce.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the ergot with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add the acetic acid and one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Erigerontis Canadensis Fluidum, U. S. P.

Take of Canada erigeron, in moderately coarse powder, sixteen troyounces.
Alcohol, a sufficient quantity.

Moisten the erigeron with half a pint of alcohol, and proceed according to the general formula for fluid extracts.

Extractum Gelsemii Fluidum, U. S. P.

Take of Yellow jasmine, in very fine powder, sixteen troyounces.
Alcohol, a sufficient quantity.

Moisten the yellow jasmine with four fluidounces of alcohol, and proceed according to the general formula for fluid extracts.

Extract Gentianæ Fluidum, U. S. P.

Take of Gentian, in moderately coarse powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the gentian with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Geranii Fluidum, U. S. P.

Take of Geranium, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the geranium with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Glycyrrhizæ Fluidum, U. S. P.

Take of Liquorice root, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the liquorice root with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Gossipii Radicis Fluidum, U. S. P.

Take of Cotton root, in very fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the cotton root with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add the fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Hydrastis Fluidum, U. S. P.

Take of Hydrastis, in very fine powder, sixteen troyounces.
Glycerin, two fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the hydrastis with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with a menstruum consisting of two parts of alcohol and one of water.

Extractum Hyoscyami Fluidum, U. S. P.

Take of Hyoscyamus leaves, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the hyoscyamus with half a pint of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Ipecacuanhæ Fluidum, U. S. P.

Take of Ipecacuanha, in fine powder, sixteen troyounces.
Glycerin, half a pint.
Stronger alcohol, a pint and a half.
Water, twelve fluidounces.
Diluted alcohol, a sufficient quantity.

Mix the stronger alcohol and water, and, having moistened the ipecacuanha with six fluidounces of the mixture, pack it firmly in a conical percolator, and pour upon it twelve fluidounces of the mixture. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, set it aside for four days, then remove the cork, and gradually pour on the remainder of the mixture, and finally diluted

alcohol, until two pints of tincture have slowly passed. Reserve the first six ounces, and mix the remainder of the tincture with the glycerin, and evaporate at a temperature not exceeding 160°, till it shall measure ten fluidounces. Finally mix them.

Extractum Krameriæ Fluidum, U. S. P.

Take of Rhatany, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the rhatany with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Lupulinæ Fluidum.

Take of Lupulin, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the lupulin with six fluidounces of stronger alcohol, and proceed according to the directions given in the general formula for fluid extracts.

Extractum Matico Fluidum, U. S. P.

Take of Matico, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the matico with half a pint of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce to the remainder of the percolate before evaporation.

Extractum Mezerei Fluidum, U. S. P.

Take of Mezereon, in moderately coarse powder, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the mezereon with six fluidounces of stronger alcohol, and proceed according to the general formula for fluid extracts.

Extractum Pareiræ Fluidum, U. S. P.

Take of Pareira brava, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the pareira brava with

four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Pruni Virginianæ Fluidum, U. S. P.

Take of Wild-cherry bark, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Water, half a pint.
Stronger alcohol, a sufficient quantity.

Mix the glycerin and water, and, having moistened the wild cherry with half a pint of the mixture, allow it to macerate in a covered vessel for four days; then pack it in a conical glass percolator, and pour on the remainder of the mixture. When this has disappeared from the surface, gradually pour on stronger alcohol until twelve fluidounces have been obtained, and set this portion aside. Continue the percolation with stronger alcohol until twenty fluidounces more have been obtained; evaporate to four fluidounces and filter through paper, rinsing the filter with a small portion of stronger alcohol, so as to preserve the measure of four fluidounces. Lastly mix this with the reserved portion and keep in a well-stopped bottle.

Extractum Rhei Fluidum, U. S. P.

Take of Rhubarb, in moderately fine powder, sixteen troyounces.
Glycerin, two fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the rhubarb with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with a mixture of two parts of alcohol and one of water.

Extractum Rubi Fluidum, U. S. P.

Take of Blackberry, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the powdered bark with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Sabinæ Fluidum, U. S. P.

Take of Savine, in moderately fine powder, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the savine with half a pint of stronger alcohol, and proceed according to the general formula for fluid extracts.

Extractum Sarsaparilla Fluidum, U. S. P.

Take of Sarsaparilla, in moderately fine powder, sixteen troyounces.
Glycerin, half a pint.
Water,
Alcohol, each, a sufficient quantity.

Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened the sarsaparilla with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Continue the percolation with diluted alcohol until twenty-six fluidounces have been obtained. Reserve the first ten fluidounces, and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces, and mix with the reserved portion.

Extractum Sarsaparillæ Fluidum Compositum, U. S. P.

Extractum Sarsaparillæ Fluidum, Pharm. 1850.

Take of Sarsaparilla, in moderately fine powder, sixteen troyounces.
Liquorice root, in moderately fine powder,
Sassafras, in moderately fine powder, each, two troyounces.
Mezereon, in moderately fine powder, three hundred and sixty grains.
Glycerin, half a pint.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened with six fluidounces of the mixture the powders previously well mixed, proceed according to the general formula for fluid extracts. Continue the percolation with diluted alcohol until two pints have been obtained. Reserve the first twelve fluidounces, and, having added four fluidounces to the remainder of the percolate, carefully evaporate to six fluidounces and mix with the reserved portion.

Extractum Scillæ Fluidum, U. S. P.

Take of Squill, in moderately coarse powder, sixteen troyounces.
Glycerin, two fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix the glycerin with fourteen fluidounces of alcohol, and, having moistened the squill with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with a menstruum consisting of two parts of alcohol and one part of water.

Extractum Senegæ Fluidum, U. S. P.

Take of Seneka, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the seneka with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Sennæ Fluidum, U. S. P.

Take of Senna, in fine powder, sixteen troyounces.
Glycerin, half a pint.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened the senna with half a pint of the mixture, proceed according to the general formula for fluid extracts. Continue the percolation with diluted alcohol until twenty-six fluidounces have been obtained. Reserve the first ten fluidounces, and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces and mix with the reserved portion.

Extractum Serpentariæ Fluidum, U. S. P.

Take of Serpentaria, in fine powder, sixteen troyounces.
Alcohol, a sufficient quantity.

Moisten the serpentaria with four fluidounces of alcohol, and proceed according to the general formula for fluid extracts.

Extractum Spigeliæ Fluidum, U. S. P.

Take of Spigelia, in fine powder, sixteen troyounces.
Glycerin, half a pint.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol with four fluidounces each of glycerin and water, and, having moistened the spigelia with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Continue the percolation with diluted alcohol until twenty-six fluidounces, have been obtained. Reserve the first ten fluidounces and, having added four fluidounces of glycerin to the remainder of the percolate, carefully evaporate to six fluidounces, and mix with the reserved portion.

Extractum Spigeliæ et Sennæ Fluidum. (*Fluid Extract of Spigelia and Senna.*) U. S. P.

Take of Fluid extract of spigelia, ten fluidounces.
Fluid extract of senna, six fluidounces.
Oil of anise,
Oil of caraway, each, twenty minims.

Mix the fluid extracts, and dissolve the oils in the mixture.

Extractum Stillingiæ Fluidum, U. S. P.

Take of Stillingia, in fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix twelve fluidounces of alcohol, three fluidounces of glycerin, and one fluidounce of water, and, having moistened the stillingia with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extractum Taraxaci Fluidum, U. S. P.

Take of Dandelion, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the dandelion with four fluidounces of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

Extemporaneous Process for the above. (Unofficinal.)

Take of Extract of dandelion	Four troyounces.
Alcohol	One fluidounce.
Water	A sufficient quantity.

Triturate the extract with the water and the alcohol, and apply a gentle heat till it is dissolved, taking care that the product measures just half a pint.

This process yields a liquid which is substantially the same in physical and medical properties with the officinal. The usual dose is a teaspoonful.*

Extractum Uvæ Ursi Fluidum, U. S. P.

Take of Uva ursi, in moderately fine powder, sixteen troyounces.
Glycerin, four fluidounces.
Alcohol,
Water, each, a sufficient quantity.

Mix half a pint of alcohol, three fluidounces of glycerin, and five fluidounces of water, and, having moistened the uva ursi with half a pint of the mixture, proceed according to the general formula for fluid extracts. Finish the percolation with diluted alcohol, and, having reserved fourteen fluidounces, add one fluidounce of glycerin to the remainder of the percolate before evaporation.

* See Succus. Taraxaci Paratus.

Extractum Valerianæ Fluidum, U. S. P.

Take of Valerian, in fine powder, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the valerian with five fluidounces of stronger alcohol, and proceed according to the general formula for fluid extracts.

Extractum Veratri Viridis Fluidum, U. S. P.

Take of American hellebore, in fine powder, sixteen troyounces.
Stronger alcohol, a sufficient quantity.

Moisten the hellebore with five fluidounces of stronger alcohol, and proceed according to the general formula for fluid extracts.

Extractum Zingiberis Fluidum, U. S. P.

Take of Ginger, in fine powder, sixteen troyounces.
Alcohol, a sufficient quantity.

Moisten the ginger with four fluidounces of alcohol, and proceed according to the general formula for fluid extracts.

Unofficinal Fluid Extracts.

Parrish's Compound Fluid Extract of Buchu.

Take of	Buchu, in coarse powder	Twelve troyounces.
	Alcohol	Three pints.
	Water	Six pints, or sufficient.

Treat the leaves by maceration and displacement, first with a portion of the alcohol, and then with the remainder mixed with the water; evaporate the resulting liquid by a gentle heat to three pints, and to this add—

Sugar	Two and a-half pounds.

Continue the heat till it is dissolved, and, after removing from the fire, add—

Oil of cubebs,*	
Oil of juniper, of each	One fluidrachm.
Spirit of nitric ether	Twelve fluidounces.

previously mixed; stir the whole together.

It will be perceived that this preparation differs from the officinal fluid extract, in containing sugar sufficient to impart sweetness to the taste, and the oils of cubebs and juniper and the spirit of nitric ether, which are not only useful as therapeutic agents in the majority of cases in which cubebs would be used, but act as antiseptics, and would render the preparation permanent without the presence of alcohol or sugar.

It has been found useful, being well adapted, by its composition, to chronic maladies of the urino-genital organs, appearing to act topically in its passage through them. The dose is a fluidrachm three or four times daily.

* Oleoresin of cubebs is much more efficient, and would much improve the remedy if substituted for it.

Fluid Extract of Hydrangea. (Dr. S. W. Butler.)

Take of Root of hydrangea arborescens . .	Sixteen troyounces.
Water	Six pints, or sufficient.

Boil the root in successive portions of water, mix them, and evaporate to half a pint; mix this with—

Honey	Two pints.

Evaporate to two pints. In the summer season push the evaporation somewhat farther, and add brandy, half a pint.

The dose is a teaspoonful twice or three times a day.

I have prepared fluid extract of hydrangea for some years, during which time I have dispensed it, under the direction of several practitioners, to numerous patients (in irritable conditions of the urethra) with satisfactory results; its value as a remedy in gravel and stone is well established.

The plant is abundant in many localities; I have gathered it on the west banks of the Schuylkill, six to eight miles above Philadelphia.

Fluid Extract of Rhubarb and Senna. (Prof. Procter.)

Take of Senna, in coarse powder	Twelve troyounces.
Rhubarb do. do.	Four troyounces.
Bicarbonate of potassium	Half a troyounce.
Sugar	Eight troyounces.
Tincture of ginger	A fluidounce.
Oil of cloves	Eight minims.
" aniseed	Sixteen minims.
Water and alcohol, of each	A sufficient quantity.

Mix the senna and rhubarb by grinding them together, pour upon them two pints of diluted alcohol, macerate twenty-four hours, and introduce the mixture into a percolator, furnished below with a stopcock or cork, to regulate the flow. A mixture of one part of alcohol and three of water should now be poured on above, so as to keep up a constant, but slow displacement of the absorbed menstruum, until one gallon of tincture has passed. Evaporate this in a water-bath to eleven fluidounces; dissolve in it the sugar and bicarbonate of potassium, and after straining, add the tincture of ginger, holding the oils in solution, and mix; when done, the whole should measure a pint. The object in adding the alkaline carbonate in this fluid extract is to prevent the griping which is apt to result from the use of the senna. The aromatics contribute to the same end. Dose, f℥j to f℥ss.

Extractum Jalapæ Fluidum. (Prof. Procter.)

Take of Jalap of good quality	Sixteen troyounces.
Sugar	Eight troyounces.
Carbonate of potassium	Half a troyounce.
Alcohol, Water, of each	A sufficient quantity.

Reduce the jalap to coarse powder, pour on it one pint of a mixture of two parts alcohol and one water, and allow it to stand

twenty-four hours. Then introduce it into a percolator, and pour ordinary diluted alcohol slowly on until half a gallon of liquid has passed. Evaporate this in a water-bath, or still, till reduced to one-half, then add the sugar and carbonate of potassium, and evaporate till reduced to twelve fluidounces. Put the liquid thus obtained, while yet warm, in a pint bottle, and add four fluidounces of alcohol, and mix by agitation.

The alkali forms a resinous soap with the jalap resin, greatly increasing its solubility in water, and at the same time renders the preparation less griping.

The object of the sugar is also to aid in the retention of the resinous matter in a fluid condition, as well as to mask the taste of the jalap. The dose will vary from fifteen minims to a fluidrachm, according to the effect desired. By means of this preparation, the physician may prescribe jalap in mixtures with great facility, and avoid the large proportion of alcohol unavoidable when he resorts to the officinal tincture.

Succus Taraxaci Paratus. (*Preserved Taraxacum Juice.*) (Prof. Procter.)

Take of Fresh dandelion root . . .	Twenty pounds (avoirdupois).
Alcohol (.835°)	Four pints.

Slice the roots transversely in short sections, and, by means of a mill or mortar and pestle, reduce them to a pulpy mass; then add the alcohol, and mix them thoroughly. The mixture, thus far prepared at the season when the root is proper for collection, may be set aside in suitable vessels (stoneware jars are appropriate), and extracted as the preparation is needed through the other seasons. After having stood a week, or until a convenient time, the pulpy mass is subjected to powerful pressure, until as much as possible of the fluid is removed. This is then filtered and bottled for use. It is necessary that sufficient time should elapse after the pulp is set aside for the alcohol to penetrate the fibrous particles and commingle with the natural juices, as well as for the woody structure of the root to lose its elasticity, that it may yield the juice more completely on pressure. When the pulp has stood six months in this, it yields the juice with great readiness, and is possessed of the sensible properties of the dandelion in a marked degree. When twenty pounds (avoirdupois) of the root are thus treated after standing several months, the practical result is about six pints of fluid with an ordinary screw press. This yield will vary in amount with the condition of the root when collected, and the length of time it is exposed afterwards, as well as the power of the press used. Should the alcohol in this preparation be contraindicated, it might be partially removed by exposure in a water-bath until the juice is reduced to five-sixths of its bulk; then for every pint of the residue, eight officinal ounces of sugar may be dissolved in it.

Fluid Extract of Galls.

Take of Galls, in coarse powder	℥viij.
Alcohol	Sufficient.

Exhaust by percolation, and evaporate to a pint.

This preparation is used by dentists in Philadelphia as a powerful astringent application.

Fluid Extract of Lobelia. (Prof. Procter.)

Take of Lobelia (the plant), finely bruised	Eight troyounces.
Acetic acid	One fluidounce.
Diluted alcohol	Three pints.
Alcohol	Six fluidounces.

Macerate the lobelia in a pint and a half of the diluted alcohol, previously mixed with the acetic acid, for twenty-four hours; introduce the mixture into an earthen displacer; pour on slowly the remainder of the diluted alcohol, and afterwards water, until three pints of tincture are obtained; evaporate this in a water-bath to ten fluidounces; strain; add the alcohol, and when mixed, filter through paper. Each teaspoonful of this preparation is equal to half a fluidounce of the tincture. The dose would vary from five drops, as a narcotic and expectorant, to twenty or thirty as an emetic.

Ferrated Fluid Extract of Wild Cherry Bark. (W. R. Warner.)

Take of Pruni Virginianæ contus.	℥xij.
Amygdalæ dulc.	℥ij.
Ferri oxyd. hydrat.	℥ss.
Sacchari albi	℥xij.
Ferri citratis	℥j + gr. xcvi.
Alcoholis,	
Aquæ, āā	q. s.

First exhaust the bark of its tonic principles with the alcoholic menstruum, and evaporate the resulting alcoholic tincture carefully to expel the alcohol; then mix the residue with six ounces of water, and add the hydrated sesquioxide of iron; allow it to macerate for six hours, occasionally agitating, and filter into a bottle containing an emulsion, composed of the two ounces of sweet almonds in six ounces of water. When the reaction has ceased between the emulsin and the amygdalin, again filter and add the sugar, and finally add 576 grains of citrate of iron, previously dissolved in water; then dilute to make the whole fluid extract measure twenty-four fluidounces.

In this formula hydrated oxide of iron is directed to be added to the extract for the purpose of removing the tannin, which would blacken on the addition of the iron salt. When effectual in accomplishing the object, it proves a useful modification of this remedy, the astringency of which is sometimes an objection to its use. Iron salt is often indicated when wild cherry would be desirable, and the selection in this formula would seem to be a

good one, though the quantity, three grains to the ounce, would seem unnecessarily large. The dose would be a fluidrachm three times a day.

Fluid Extract of Sanguinaria. (Samuel Campbell.)

Take of	Sanguinaria canadensis	Eight troyounces.
	Acetic acid, No. 8	Two troyounces.
	Water	Ten troyounces.
	Sugar	Eight troyounces.
	Diluted alcohol, of each	A sufficient quantity.

Reduce the root to a coarse powder, then incorporate it with the acetic acid, previously mixed with the water. After allowing it to macerate for forty-eight hours, transfer to a glass percolator, and exhaust by means of diluted alcohol. By means of a water-bath evaporate the tincture to twelve fluidounces, then add the sugar, and, when dissolved, strain.

The preparation is of a deep red color, with an intensely acrid taste. Each fluidrachm represents thirty grains of the root.

Extractum Anthemidis Fluidum. (Prof. Procter.)

Take of	Chamomile flowers	Eight troyounces.
	Sugar	Eight troyounces.
	Alcohol,	
	Diluted alcohol, of each	A sufficient quantity.

Bruise the chamomile thoroughly, pour on it a pint of alcohol, and macerate for twenty-four hours, pack it moderately tight in a percolator, and pour on slowly diluted alcohol, until a pint of liquid has passed; then change the recipient, and continue the process until two pints more of tincture are obtained. Evaporate the first tincture by a gentle heat, or spontaneously, to six fluidounces, and the other in a water-bath to four fluidounces, mix the liquids, add the sugar to them, dissolve by a gentle heat, and finally add alcohol until the whole measures a pint.

The dose of this preparation is from one to two teaspoonfuls as an anti-periodic, or half a teaspoonful as a tonic; a fluidrachm represents thirty grains of chamomile flowers.

Fluid Extract of Sumbul. (*Musk Root.*) (Prof. Procter.)

Take of	Musk-root	Four troyounces.
	Ether	Four fluidounces.
	Alcohol,	
	Water, each	Sufficient.

Bruise the root, moistened with a little alcohol, until reduced to a coarse powder. Mix the ether with twice its volume of alcohol, pour it on the musk-root, macerate in a covered vessel for 24 hours, and introduce into a suitable percolator; displace the absorbed tincture slowly by alcohol until twelve fluidounces are obtained, when the process is to be continued with a mixture of equal parts of alcohol and water, until a pint has passed. Water is then to be poured on the residue until a pint of liquid has filtered. The

ethereo-alcoholic tincture is suffered to evaporate in a warm place, until reduced to two fluidounces; the hydro-alcoholic tincture is concentrated on a water-bath to the same bulk; and the watery infusion evaporated to one fluidounce. The last two liquids are now to be mixed, three fluidounces of alcohol added to the first (ethereal) liquid, to dissolve the oleoresin, and the other mixture added gradually with agitation, so that the whole will measure eight fluidounces; the mixture is to be afterwards shaken occasionally for 24 hours. A portion of oleoresin and some gummy extractive remain undissolved, and must either be removed by filtration or left as a sediment.

When the ethereo-alcoholic tincture is evaporated to one-sixth, nearly all the oleoresin separates, and hence the necessity of redissolving this by alcohol before adding the other liquids.

The dose of this is fifteen minims to f℥j. It has the odor of musk and the antispasmodic effects of valerian. The root is used in Russia in delirium tremens, and has been somewhat prescribed in Philadelphia and elsewhere in a variety of nervous affections.

Fluid Extract of Lactucarium. (I. H. Rowley.)

Take of Lactucarium (English)	Four troyounces.
Glycerin	Two fluidounces.
Alcohol,	
Water, each	A sufficient quantity.

Macerate the lactucarium, previously comminuted, in a mixture of f℥j of glycerin, f℥iiiss of alcohol, f℥iiiss of water, for four days, then put into a percolator, and pour on diluted alcohol until six fluidounces have passed, set this aside, and continue the percolation until nine fluidounces more of percolate have been obtained, to this add the remaining fluidounce of glycerin, and evaporate gently to f℥ss, then add f℥ss of alcohol and mix with the tincture reserved, allow it to stand twenty-four hours, and filter.

Fluid Extract of Scutellaria Laterifolia.

Skullcap, though not much prescribed by regular physicians, is greatly esteemed by the eclectic practitioners, who employ it in several different preparations in the treatment of nervous irritation. The mode of preparation indicated by Prof. Maisch is to exhaust sixteen ounces of the powdered herb by the use successively of diluted alcohol, and a mixture of four parts of water and one of alcohol, then to evaporate the mixed liquids to about a pint, add one pound (officinal) of sugar, and further evaporate to one pint.

Fluid Extract of Marrubium Vulgare.

Horehound ranks as a tonic, and is much used in the form of syrup, candy, and hot infusion as a domestic remedy for *colds*, incident to our changeable climate.

The fluid extract may be made exactly as the foregoing, substituting horehound for the skullcap.—*Proceedings Am. Pharm. Assoc.*, 1857.

Oleoresinæ, *U. S. P.*

The Oleoresins.

The officinal preparations of this class were, in the *Pharmacopœia* of 1850, denominated fluid extracts, and classified under that head; they have been, in the more recent revision, made a separate class, and are shown in the following syllabus:—

Officinal Oleoresins.

Officinal name.	Medical properties, etc.	Yield.	Dose.
Oleoresina capsici	Arterial stimulant	18 per cent.	?
" cubebæ	Stimulant, diuretic	12 to 25 p. ct.	5 to 30 drops.
" filicis	Anthelmintic	.....	♏ v to xv
" lupulinæ	Tonic, narcotic, etc.	.....	5 to 10 drops.
" piperis	Stimulant	6 per cent.	1 to 5 drops.
" zingiberis	Stim., carminative	9 per cent.	do.

REMARKS.

These preparations are made by passing *ether* through the powdered drug in a covered displacement apparatus, recovering the ether or allowing it to evaporate spontaneously. The resulting liquid is of a more or less oily consistence; usually of a dark color —brown, or with a tinge of green (red in capsicum); extremely pungent, and reminding one of the drug. It consists of the essential oil holding in solution a portion of the waxy and resinoid principles associated with it in the drug. These are apt to be deposited in part, a circumstance which modifies somewhat the properties of different specimens of the same preparation. In the instance of fluid extract of pepper, the piperin is directed to be separated, and the oil of black pepper of commerce, which is similar to the fluid extract, is a residuary product of the manufacture of piperin. Cubebs yield from 12 to 28 per cent. of oleoresin; black pepper about one-sixteenth of its weight; ginger from 6 to 9 per cent.

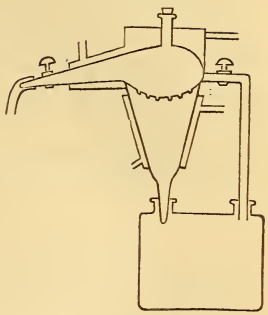
Owing to the solubility of fixed oils and fatty matters in ether, these, if present in the drug, are extracted, and are associated with the oleoresinous preparation left after the evaporation. In the oleoresins of cardamom and ergot the fixed oils are conspicuous though inert ingredients; from capsicum the fatty matter is obtained in a solid form, and is readily separated.

The uses of the oleoresins are limited to those preparations in which they can be suspended by viscid ingredients, or embodied in pills, lozenges, or for external use added to liniments or ointments.

Fig. 233 exhibits a section of an arrangement by which the oleoresins, and other preparations requiring the use of ether as a menstruum, can be most conveniently prepared. A percolator of tinned copper is surrounded by a jacket of the same material; the recipient is a copper vessel with two necks, into one of which the percolator is

secured, and to the other a pipe connecting with the close head of the percolator, which is also jacketed; on the under side of the head is a perforated plate of tinned copper, which distributes the ether over the surface of the drug when it has been volatilized by placing the recipient in hot water. After the exhaustion of the drug, the recipient is removed, the lower orifice of the percolator closed, and the head well refrigerated; a stream of hot water is then passed into the jacket around the percolator, by which means the contained ether may be recovered.

Fig. 233.



Oleoresin of capsicum has, perhaps, but little use, unless as an external remedy; it would seem too strong to be taken internally with any advantage, but may be added to stimulating liniments. *Oleoresin of cubebs* (formerly fluid extract of cubebs) is a valuable addition to copaiva mixtures for use in the chronic stages of gonorrhœa; it is also adapted to the fabrication of lozenges for sore throat, coryza, etc. *Oleoresin of lupulin*, like the fluid extract and solid extract, is an efficient though mild narcotic; by being suitably suspended in mucilage it would be capable of use in mania-a-potu and as an antaphrodisiac.

Oleoresin of black pepper is used in connection with sulphate of quinia, in pills, to the efficiency of which it is said to add; it would seem to be a better adjuvant to that tonic than piperin, prescribed in the old recipes. *Piperoid* (oleoresin) *of ginger* is of most use in connection with the fabrication of ginger drops, of fused candy, and lozenges; it may be added also to mixtures containing viscid ingredients, or to alcoholic preparations. It is a dark brown, transparent, oily liquid, extremely pungent, insoluble in water, but soluble in ether and strong alcohol. Ginger is said to contain about $1\frac{1}{2}$ per cent. vol. oil, and $3\frac{8}{10}$ per cent. soft resin. The proportion yielded by the root, treated as above, varies with the commercial variety of ginger. A commercial pound of African ginger yielded, by this process, one and a half ounce, or 9.3 per cent., while the same quantity of the Jamaica variety yielded only one ounce—6.2 per cent. That from the African was darker in color, thicker, and somewhat less pleasant than the other. One ounce of the piperoid added to twenty pounds of melted sugar, makes "ginger drops" of about the usual pungency. *Oleoresin filicis* is a new officinal in the revision of 1870, and is much relied upon as a remedy in tænia, in doses of six to twenty minims.

Working Formulas for the Oleoresins.

Oleoresina Capsici, U. S. P.

Take of Capsicum, in fine powder, twelve troyounces.
Ether, a sufficient quantity.

Put the capsicum into a cylindrical percolator provided with a

stopcock and arranged with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it until twenty-four fluidounces of filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, remove, by straining, the fatty matter which separates on standing, and keep the oleoresin in a well-stopped bottle.

Oleoresina Cubebæ, U. S. P. (*Oleoresin of Cubeb.*)

Take of Cubeb, in fine powder, twelve troyounces.
Ether, a sufficient quantity.

Put the cubeb into a cylindrical percolator, as described in last formula, press it moderately, and gradually pour ether upon it until twenty-four fluidounces of filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a well-stopped bottle.

Oleoresina Filicis, U. S. P. (*Oleoresin of Fern.*)

Take of Male fern, in fine powder, twelve troyounces.
Ether, a sufficient quantity.

Put the male fern into a cylindrical glass percolator provided with a stopcock and arranged with covered receptacle suitable for volatile liquids, press it firmly, and gradually pour ether upon it until twenty-four fluidounces of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a well-stopped bottle.

Oleoresina Lupulinæ, U. S. P.

Take of Lupulin, twelve troyounces.
Ether, a sufficient quantity.

Put the lupulin into a narrow cylindrical percolator, as described in formula for oleoresin of capsicum, press it firmly, and gradually pour ether upon it until thirty fluidounces of filtered liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, keep the oleoresin in a wide-mouthed bottle well stopped.

Oleoresinæ Piperis, U. S. P. (*Extractum Piperis Fluidum*, U. S. P. 1850.)

Take of Black pepper, in fine powder, twelve troyounces.
Ether, a sufficient quantity.

Put the black pepper into a cylindrical percolator, as described in formula for oleoresin of capsicum, press it firmly, and gradually pour ether upon it until twenty-four fluidounces of filtered liquid

have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated, and the deposition of piperin in crystals has ceased. Lastly, separate the oleoresin from the piperin by expression through a muslin strainer, and keep it in a well-stopped bottle.

Oleoresina Zingiberis, U. S. P. (*Piperoid of Ginger.*)

Take of Ginger, in fine powder, twelve troyounces.
Stronger ether, twelve fluidounces.
Alcohol, a sufficient quantity.

Put the ginger into a cylindrical percolator, press it firmly, and pour upon it the stronger ether. When this has been absorbed by the powder, add alcohol until twelve fluidounces of filtered liquid have passed. Recover from this, by distillation on a water-bath, nine fluidounces of ether, and expose the residue in a capsule until the volatile part has evaporated. Lastly, keep the oleoresin in a well-stopped bottle.

Unofficinal Oleoresins.

Oil of Asarum Canadense.—Canada snakeroot or wild ginger is prepared in the same way; it is used chiefly as a perfume; it is also gratefully stimulant in small doses, being not unlike ginger in its properties.

Oil of cardamom, prepared in the same way with ether, is an impure oily fluid, containing both the fixed and volatile oil of the seeds, and esteemed a powerful carminative stimulant; it is little known to practitioners.

Oil of parsley is a diuretic remedy, sometimes called *apiol*. It is prepared by treating parsley seeds with strong alcohol, and subsequently with ether or chloroform; these menstrua are then distilled off, and the oil may be further purified if desired. It is also prepared by the spontaneous evaporation of an ethereal tincture, as in the other cases. It is highly charged with the odor of the plant, of which it is probably the chief active constituent. Dose, 3 or 4 drops in a day.

This remedy has been highly lauded as a substitute for quinia in intermittents. It has been introduced in Philadelphia, in capsules, sold as a powerful emmenagogue, and it is believed is surreptitiously used to commit abortion.

Oil of Ergot.—Under this name a brown colored, acrid, oily liquid is sold in the shops, which is obtained by treating powdered ergot with ether, or a mixture of ether and alcohol, and evaporating off the menstruum. Its most bulky ingredient is the peculiar bland fixed oil, which, according to the experiments of T. Roberts Baker, is nearly isomeric with castor oil. My friend, Ambrose Smith, informs me that he has found oil of ergot, when made with pure ether, to become inconveniently thick—almost solid; which difficulty is obviated by adding a portion of alcohol to the ether em-

ployed. Although the pure fixed oil is destitute of any of the effects of ergot, this preparation, owing to its other ingredients, is more or less active. Its dose, in cases of labor, to promote uterine contractions, is from 20 to 50 drops.

Oil of Pumpkin Seed.—This oil, though not an oleoresin, and consequently not strictly classed here, has been used with success as a remedy in tænia. It is conveniently prepared by crushing the seeds to a smooth pulp, transferring to a percolator after moistening with ether, and permitting the mass to stand an hour in a close vessel; it should be displaced with ether, and from the liquid thus obtained the ether should be removed by evaporation. The dose is f℥ss repeated in two or three hours, and followed by a dose of castor oil. About 33 per cent. of oil is the yield by this process.

CHAPTER XII.

SYRUPS AND HONEYS.

Of Syrups.

The term Syrup is applied to any saturated or nearly saturated solution of sugar in water, and there are numerous simple, medicated, and flavored syrups used in medicine and pharmacy, both officinal and unofficinal. The kind of sugar used in the officinal preparations is that named in the list of the *Pharmacopœia* Saccharum, and called refined sugar, loaf sugar, or—as variously powdered—broken down, crushed, or granulated sugar. These, as supplied by the refineries, consist of nearly chemically pure cane sugar, and require no further preparation for pharmaceutical use. Sugar is soluble in less than half its weight of water; to a less extent in alcohol, and insoluble in ether. It crystallizes from its solution in the form of oblique rhombic crystals, containing water, called, as found in the shops, rock candy. (*See* Part IV.)

The advantages of the use of sugar in pharmaceutical preparations are, 1st. Its agreeable taste. 2d. The viscidity and blandness of its solution. 3d. Its conservative properties, when in sufficient proportion. These adapt it to numerous uses in pharmacy, among which the preparation of syrups is, perhaps, the most important. The number of medicated syrups in common use, and the great popularity of these among physicians and the public, are characteristics of French and American pharmacy as contradistinguished from that of Great Britain.

The proportion of sugar in syrup is a matter of primary importance, as, owing to nitrogenized principles, which are apt to be accidentally present, even in simple syrup, fermentation will be set up, unless the syrup has very nearly the full officinal proportion.

Previously to the revision of the *U. S. Pharmacopœia* in 1860, the

officinal directions ordered an excess of sugar in the preparation of most syrups; to Dr. Wilson H. Pile we owe the accurate estimation of the quantity required to produce saturation, and the precise increase of bulk caused by sugar in solution. In accordance with his suggestions and those of Dr. Squibb, the proportion of sugar has been slightly reduced in most of the formulas, and the degree of evaporation regulated so that the required proportion of resulting syrup to the drug employed, shall be accurately maintained. By calculation, founded on its specific gravity, 12 troyounces of sugar = 5760 grains, produce in solution 8 fluidounces, but owing to a slight condensation the actual increase, as ascertained by experiment, is 7.941 fluidounces; practically two-thirds of the weight of sugar will equal its bulk in fluidounces. In the formulas of the previous *Pharmacopœias* 30 troyounces were prescribed to a pint of water, to make two pints of syrup, in the present 36 troyounces are directed to 20 fluidounces to make 2 pints and 12 fluidounces (= 44 fluidounces), any evaporated water being substituted by the addition through the strainer of exactly sufficient to bring it up to the required measure. The specific gravity of officinal simple syrup is 1.317, but the several medicated syrups vary from this, in consequence of the presence of extractive and other principles.

The following curious rule is given by Dr. Ure for ascertaining the quantity of sugar in simple syrup: "The decimal part of the number denoting the sp. gr. of a syrup multiplied by 26 gives the number of pounds of sugar it contains per gallon very nearly." This appears to refer to the avoirdupois and not the officinal weight.

In the absence of extraneous and particularly of nitrogenized principles, a syrup will keep well enough in cold weather, without reference to its proportions; but in a majority of instances of medicated syrups, it is absolutely necessary to observe the above well-established proportions, which insure a nearly saturated saccharine solution.

If impure or brown sugar is employed, it is necessary to boil the syrup until the proper specific gravity is attained, skimming or straining off the scum which contains the impurities; but when the sugar is pure, and there are no other vegetable impurities to be separated, a boiling temperature is unnecessary.

If impurities are diffused in the liquid, which will not readily rise as scum, it is well to add, before applying heat, a little white of egg, previously beaten up with water, which, by its coagulating at the boiling temperature, forms a clot, inclosing the impurities, and facilitating their removal; it may also be rendered clear and bright by diffusing filtering paper reduced to a pulp through the syrup, and then separating by straining through a woollen flannel, which will felt with it; if the syrup is not clear it should again be poured through, and it will then become clear. A richer and more elegant syrup is produced by the use of Havana sugar, clarified in this way, than from the best refined sugar, and some of our most careful pharmacists use this process for their mineral water syrups,

on account of its superior product, though so much more troublesome.

In some of the medicated syrups, a boiling temperature is directed, in order that the vegetable albumen contained in the medicinal ingredient may be coagulated, and thus separated. This should be done before adding the sugar, and the liquid should then be filtered, so that a perfectly clear syrup may be obtained from the first. Syrups may be decolorized by filtration through animal charcoal, and to obtain perfect transparency should be strained slowly, after they are partially cooled, through two or three thicknesses of flannel. In many instances, the presence in the drug, or in the menstruum employed, of antiseptic properties, insures the permanence of the preparation. Syrup of squill is an instance, in which, owing to the presence of the antiseptic element, acetic acid, in the menstruum, we are enabled to reduce the proportion of sugar somewhat below that necessary in other instances. Among the articles added to syrups, to prevent fermentation, the following may be mentioned:—

Essential oils, which, of course, greatly modify the taste and other properties of the preparation. *Brandy*, which is much used with aromatics; a small proportion of pure *alcohol; glycerin*, which does not alter the taste or other properties of the preparation. *Sugar of milk*, in small proportion. *Sulphite of lime*, a small proportion of which will effectually prevent or arrest fermentation, though it is liable to impart an odor unless afterwards subjected to heat. *Hoffmann's anodyne* is one of the best antiseptics, though objectionable as imparting an ethereal odor and taste; it should, however, be added in small quantity only; one fluidrachm to a pint has generally answered the purpose, and in cases where an acid is not objectionable acetic acid in proportion of f℥j to the pint is very efficient.

It must not be forgotten, in attempting to restore syrups that have fermented, by boiling them, that they have lost sugar in proportion to the amount of acetic acid produced, and this must be restored when they are heated, besides the addition of the antiseptic. Syrups should be kept in a cool, though not in a cold, place; those most liable to ferment, in small and well-stopped bottles.

Syllabus of Officinal Syrups.

1st Group.—Used as excipients and flavors.

Officinal name.	Constituents, etc.
Syrupus,	Sugar ℔iij (troy) + water f℥xx = 2 pints and 12 fluidounces, or weigh fifty-five troyounces.
Syr. acaciæ,	Sugar 14 parts + gum 2 + water 8 fluid parts.
" amygdalæ,	Emulsion of sweet and bitter almonds + sugar.
" aurantii cort.,	Sweet orange-peel (oil extracted) + carb. magnes , sugar, and water.
" " florum,	Orange-flower water + sugar.
" acidi citrici,	Acid ℥j, oil lemon ♏ ij, syrup Oj
" limonis,	Lemon juice and water equal parts + sugar.
" tolutanus,	Tinct. + carb. magnes. + sugar and water.
" zingiberis,	Fld. ext. " + sugar and water.
" rosæ gallicæ,	Extracted with dil. alc., astringent.

REMARKS.

Simple Syrup, as made by the officinal working formula appended, is a viscid liquid, constituted of about two-thirds sugar and one-third water, and having a specific gravity, when boiling hot, of 1.261 (30° Baumé); or when cold, 1.317 (35° Baumé). (Syrups prepared from the juices of fruits, or others which contain much extractive matter, mark about 2° or 3° higher on Baumé's scale.) It is of a pure sweet taste, without odor, when freshly prepared. The boiling point is 221° F. It is much used as a vehicle and to sweeten extemporaneous mixtures, also in the preparation of some of the medicinal syrups (second group). In certain chemical solutions it is found useful as preventing the oxidation of the metallic base by excluding contact with atmospheric oxygen. In compounding pills its adhesiveness renders it a useful excipient, though less so than honey, or molasses, or the next member of the group.

Syrup of gum is a very viscid and adhesive fluid, especially useful in compounding prescriptions; this syrup of the *Pharmacopœia* must be distinguished from the French *Sirop de Gomme*, which is flavored with orange flower; this, diluted with water, is a favorite demulcent drink. Our syrup is a saturated solution of gum Arabic and sugar, so adjusted as to be permanent; it is very viscid, so much so as to be only fitted for suspending insoluble substances, and for combining unadhesive materials in pill. The use of well-selected gum Arabic, in lumps, as directed in the officinal formula, insures a clearer and more elegant syrup than can be made from the ordinary powdered gum.

Almond or *orgeat syrup* is a delightful preparation for use as a drink with carbonic-acid water; it is frequently modified by the addition of orange-flower water, vanilla, or other flavoring materials, which, however, seldom improve its delicate flavor. Its process involves, first the blanching of almonds by maceration in warm water, and then pressing out the kernels from the skins between the fingers, or by rubbing them between cloths; second, the beating of these into a paste with a portion of sugar; third, the formation of a milky mixture or emulsion by trituration with successive portions of water; and fourth, the solution in this of the required quantity of sugar, which should be done without exposure to a high heat.

In *syrup of orange-peel*, the fresh rind of the sweet or Havana orange is preferred to the bitter orange-peel prescribed in the various tonic preparations, this syrup being used for its flavor rather than for any medicinal effect. The method adopted in the officinal formula for the extraction of this delicate flavor of the peel is quite original and adapted to preserve it in perfection. The formula for orange syrup, among the mineral water syrups, contains also the juice of the fruit, and it is not so well adapted to medicinal preparations.

Syrup of orange-flower is necessarily made from the imported distilled water, as the flowers are not obtainable in a fresh condition except in remote situations in our southern States. This flavor is

increasingly popular in this country, and the distilled water is so decidedly sedative in its effects on the nervous system as to constitute a valuable remedy, either singly or in appropriate combinations.

Lemon syrup and *syrup of citric acid* are familiar and grateful refrigerant drinks, adapted to use as adjuvants in extemporaneous pharmacy. The former has been reduced in strength in the late revision of the *Pharmacopœia;* it was formerly made by dissolving sugar in the pure lemon juice; this is now diluted, previously, with an equal bulk of water; the syrup is thus more nearly like syrup of citric acid, which, beside being so easily made extemporaneously, is a rather more elegant preparation. Lemon syrup depends, for quality, mainly on the freshness of the lemon juice; citric acid syrup on the purity and freshness of oil of lemon.

Ginger and Tolu syrups are made, according to the last edition of the *Pharmacopœia*, by the trituration of the concentrated tincture, in the case of tolu and fluid extract of ginger, with carbonate of magnesium and a small portion of sugar, thus making an aromatized water, which is rendered clear by filtration and converted into a syrup by the addition of sugar in the usual way; this is nearly the same plan adopted in the preparation of syrup of orange-peel, and furnishes an unexceptional aromatized syrup, though requiring more manipulation and consuming more time than the process of the *Pharmacopœia* of 1840, which directed the addition of the tinctures to simple syrup, as prescribed for ginger syrup under the head of mineral water syrups. Syrup of tolu is a useful balsamic expectorant, but too week to produce a decided effect, such as is obtainable by the tolu mixtures, described among the extemporaneous preparations.

Syrup of red rose is a mild astringent, and may be regarded as a medicinal or a flavoring preparation; its color is one of its merits as an adjuvant. In its mode of preparation, it belongs to the *third group.*

2D GROUP.—Prepared by adding simple syrup to fluid extract.

Officinal name.	Proportions.	Dose.	Medical properties, etc.
Syr. ipecacuanhæ	f℥j to Oj	f℥j	Expectorant, most used for children.
" rhei (simp.)	f℥iss to Oj	f℥ij	Laxative " " "
" rubi (blackberry root)	f℥iv to Oj	f℥ss	Astringent.

REMARKS.

These very familiar preparations, by the late revision of the officinal formulas, are rendered quite convenient in their mode of preparation. This mode is well adapted to a variety of syrups which may be made extemporaneously from the corresponding fluid extracts. The " eclectic formularies" direct various proportions—one part of fluid extract to 3, 4, 7, 8, and 14 of simple syrup.

Syrup of ipecacuanha is a most useful expectorant, and in domestic practice is perhaps the most popular, in Philadelphia. It is parti-

cularly adapted to the treatment of the catarrhs of children. The dose may be so regulated as to produce a gentle relaxing, or, in the case of children, emetic, effect, with the advantage of causing neither stimulating nor depressing after-effects. The strength of this syrup is doubled in the edition of 1860.

Simple syrup of rhubarb is also an excellent preparation when made by the new officinal process; it is very extensively used as a mild carthartic for children. It is very different in its properties and mode of action from the aromatic syrup referred to in the next group; the proportion of rhubarb is larger than in the former editions.

Syrup of blackberry root (*syrupus rubi*) is another new officinal (1860), which is designed to meet the demand for an approved preparation of our indigenous blackberry root. Most of these as now prepared by pharmacists are rendered popular by introducing aromatics, some of which class, it would seem, would have been desirable additions. The process in the new edition of the *Pharmacopœia* is very simple, and consists in mixing the fluid extract with simple syrup.

3d Group.—Extracted by diluted alcohol, which is evaporated.

Officinal name.	Proportions.	Dose.	Medical properties.
Syr. lactucarii	℥j to Oj	f ℥j	Mild narcotic.
" senegæ	℥iv to Oj	f ℥j	Acrid, expectorant.
" scillæ comp.	sq'l ℥iv, s'ka ℥iv, ant. T. gr. j=f℥j } to Oiij	f ℥j	Expectorant, emetic.
" (Coxe's hive syrup)			Arterial sedative.
" rhei aromat.	rh. ℥iiss to Ovij	f ℥ss	Laxative, carminative.
" sarsap. comp.	sars. ℥iv to Oj	f ℥ss	Alterative, diaphoretic.

REMARKS ON THE THIRD GROUP.

The simplest statement of this process for making syrups is the following: Of the drug, properly powdered, make a tincture by percolation with diluted alcohol; evaporate this, in a capsule, to the point named in the *Pharmacopœia*, thus getting rid of the alcohol contained in it; add sugar, in the proportion of two parts to one of the liquid, and dissolve it by the aid of heat.

Of this important class each individual should be carefully studied and the working formula should be followed strictly in preparing them. The importance of the use of officinal weights, or their equivalents in the commercial weights, need hardly be insisted upon.

Syrup of lactucarium is a new officinal in the *Pharmacopœia* of 1860; it is much stronger than *Aubergier's syrup*, which has been extensively prescribed of late years, and a formula for which is given among the unofficinal syrups. This new preparation is prepared by trituration and percolation with diluted alcohol, the evaporation of this tincture and its incorporation with simple syrup. It has a very bitter taste, is destitute of any flavoring ingredient, and

contains about four grains to each fluidracnm. A teaspoonful containing from five to six grains is a medium dose. The *Pharmacopœia* does not designate, in the list, whether "English" or "German" lactucarium shall be used; the former is the more active narcotic. The pharmacist who has at hand the fluid extract of "English" lactucarium, described in the chapter on fluid extracts, may prepare the officinal syrup by adding one fluidounce to a pint of simple syrup, previously heated, and straining while hot.

Syrup of red rose is a mild astringent, and from its rich color and flavor, when prepared from the fresh and unfaded flowers, is well adapted to use as an adjuvant in extemporaneous pharmacy. The process varies from the foregoing in the use of sugar instead of syrup, and the reservation of the first portion of the percolate to be added at the close of the process.

Syrup of seneka is prepared by the process pertaining to this group; the evaporated tincture is to be filtered previously to adding the sugar. We have been accustomed, perhaps without sufficient reason, to bring this, like the following, to the boiling point before filtration, to promote the precipitation of inert fermentable matter.

Coxe's hive syrup (*syr. scillæ comp.*) has been a subject of much discussion with reference to its mode of preparation. As originally prepared, many years ago, it contained honey, which being objected to from its alleged agency in promoting fermentation, it was superseded, in the revision of 1840, by sugar, the preparation being removed from *mellita* to *syrupi*. The use of diluted alcohol in its preparation was esteemed a great improvement; but it is still an opprobrium of our art on account of its liability to ferment.

The precaution should not be neglected in this instance, of boiling the diluted alcoholic preparation during the evaporation, and filtering, before adding the sugar. A copious coagulation of the vegetable albumen takes place at the boiling temperature, the removal of which on the filter obviates, to some extent, the tendency to fermentation in the resulting syrup. The solution of the tartar emetic in the syrup should be accomplished, while it is hot, by trituration in a mortar, as prescribed under the head of Solution.

Spiced syrup of rhubarb is improved in its method of preparation, in the last revision of the *Pharmacopœia*, by omitting the evaporation of the percolate obtained by treating the rhubarb and aromatics with diluted alcohol; the presence of the alcohol aids in the therapeutic effects in view. An old recipe for this preparation, credited to the late Dr. James, and preferred in practice by my father, the late Dr. Joseph Parrish, and some contemporaneous practitioners, prescribes a considerable portion of French brandy, not to be evaporated, but retained in the syrup when finished. To meet this preference, the rhubarb and aromatics may be percolated with brandy, which may be mixed with the proper proportion of syrup, thus rendering the preparation more decidedly stimulating.

Compound syrup of sarsaparilla is the only remaining member of this group; its composition is similar, though not identical, with the fluid extract, which contains mezereon, a most acrid and stimu-

lating alterative; the syrup contains, besides the soluble principles of sarsaparilla, those of guaiacum-wood, rose, senna, and liquorice root, extracted by diluted alcohol, evaporated, and made into a syrup, as before indicated for the syrups of this group. For the improvement of its flavor, and as antiseptics, the oils of anise, sassafras, and partridgeberry are directed to be added, and the proportion of sugar is properly rather less than that indicated for syrups generally.

Therapeutically considered, this is a most important group of syrups. As expectorants and ingredients of expectorant compounds, *compound syrup of squill and syrup of senega* are much prescribed; the former has for many years been a most common remedy in croup; it is not, however, popular either among physicians or pharmacists, the former regarding it as therapeutically, and the latter as pharmaceutically, objectionable. The presence of the antimonial salt, in the proportion of a grain to the ounce, should always be remembered; it is an arterial sedative by no means indicated in many cases to which the other expectorant ingredients would be applicable.

In croup, it is customary to increase the dose of hive syrup very much above that mentioned in the books, or to repeat it every fifteen or twenty minutes till the patient vomits. The dose for a child one year old may be ten drops, for one of two years fifteen, of three years twenty-five drops, and so on, repeated as above. Syrup of seneka is the most acrid of its class; its use is indicated in chronic catarrh not accompanied by inflammatory action; it is seldom urged so as to produce its emetic effect, except in combination with other remedies.

In compounding expectorant and sedative remedies, *syrup of lactucarium* will be a convenient anodyne, destitute of astringency, and will probably be more used in that way than by itself.

Spiced syrup of rhubarb is, probably without exception, the most familiar remedy for the so-called summer complaint of children, the form of diarrhœa, usually connected with teething, so extremely prevalent and fatal in our large cities during the intense heat of summer. It has the advantage of being a warming tonic or stomachic, as well as a very mild laxative, and is given in doses from a teaspoonful for an infant of a year old to a tablespoonful or more for older children and adults.

Compound syrup of sarsaparilla is manufactured in very large quantities by pharmacists, and, after many fluctuations, has an extended reputation among practitioners of medicine, as well as the public at large. Its chief use is in skin diseases, and in syphilitic and scrofulous cases, in which it is used both alone and combined with mercurials, iodides, etc.

The extensive range of diseases to which sarsaparilla is applicable, and the harmless character of the remedy, have made it a great favorite with empirics, so that there are an immense number of quack medicines sailing under its name, and not a few called alteratives and panaceas, which contain it as one of their ingredients.

So numerous and so generally popular were these, several years ago, that the period of their greatest popularity, from 1845 to 1850, has been called among druggists the "sarsaparilla era." Many of these, as the notorious Townsend's, the chief merit of which was its great dilution and the large size of the bottles in which it was put up, have gone into merited disuse, while a few are yet in demand.

It is greatly to be regretted that educated physicians should so frequently lend their influence to the empiric by countenancing, and even recommending, these medicines, some of which may no doubt be found useful in their hands, but, besides the disadvantage of our being ignorant of their composition, they are generally inferior to the officinal and other legitimate preparations, in medicinal virtues.

4TH GROUP.—Of syrups. Extracted and dissolved by water.

Officinal name.	Proportions.	Dose	Medical properties.
Syr. krameriæ	{ Rt. ℥vj to Oj { Ext. ℥j to Oj	fℨj	Astringent.
" pruni Virg	℥iiss to Oj	fℨij	Tonic, nerv. sedative.
" ferri iodid.	gr. 58 to f℥j	gt. v to xx	" alterative.

REMARKS ON THE FOURTH GROUP.

Syrup of rhatany is made either directly from the powdered root by percolation with cold water, evaporation, and incorporation with sugar, or from the fluid extract by mixing twelve fluidounces of it with twenty-four fluidounces of syrup. This syrup leaves nothing to desire as an elegant and efficient astringent, and one which is prepared with great facility.

Syrup of wild cherry is also made by percolation with cold water; the process requires care to be successful in extracting the whole of the soluble principles with the small amount of water allowable; evaporation is inadmissible on account of the great volatility of the contained hydrocyanic acid. The full production of this from the amygdalin and emulsin contained in the bark suggests the precaution of subjecting the powder to the action of water for twenty-four hours previous to displacement, as directed in the *Pharmacopœia.* The infusion acquires richness of flavor and color by standing until a precipitate begins to form in it, before adding the sugar. In this instance, less than the full proportion of sugar directed for syrups, generally, is sufficient to preserve it, owing to the antiseptic properties of the hydrocyanic acid.

Syrup of wild cherry is one of the most popular and really valuable of tonic and sedative remedies, being much used in pulmonary affections, connected with an atonic condition and harassing cough.

5TH GROUP.—Syrups containing acetic acid.

Syrupus allii. By maceration of garlic, ℥vj, in dil. acet. acid. Oj, sugar being afterwards added. Antispasmodic. Dose, f℥j.

" scillæ. Vinegar of squill Oj + sugar ℔ij. Expectorant. Dose, f℥j.

Of these, the first is but rarely used; but the second is an extremely common expectorant, used both by itself and in combination with camphorated tincture of opium, tincture of digitalis, syrup of ipecacuanha, and other medicines. The presence of the acetic element takes from this preparation the cloying character which belongs to the syrups generally.

Working Formulas for the Officinal Syrups.

Syrupus. (*Simple Syrup.*) U. S. P.

Take of Sugar, in coarse powder, thirty-six troyounces.
Distilled water, a sufficient quantity.

Dissolve the sugar, with the aid of heat, in twenty fluidounces of distilled water, raise the temperature to the boiling point, and strain the solution while hot. Then incorporate with the solution a sufficient quantity of distilled water, added through the strainer, to make the syrup measure two pints and twelve fluidounces, or weigh fifty-five troyounces. Syrup, thus prepared, has the specific gravity 1.317.

My judgment coincides with that of some others in preferring to make syrup with a very slight excess of water, not only on account of the convenient relations of the commercial weights to the required proportion of liquid by measure, but also because it is, on the whole, more satisfactory. There is always some waste of the fluid by evaporation where heat is applied, and when the full officinal proportion of sugar is used, a portion is liable to crystallize out on standing, and thus by abstracting sugar weaken the remainder, unless the direction given in the above formula for supplying the loss by evaporation is carefully and accurately complied with, which, on the large scale in which syrups are generally made, is not to be expected.

Reduced to commercial or avoirdupois weights, the right proportion to make syrup of standard strength is a pound of sugar to eight fluidounces and a fluidrachm of water; the fluidrachm is obviously superfluous, and hence is omitted in the following formula, which I have used for many years with satisfaction:—

Simple Syrup.

Take of Sugar	2 lbs. com.	80 lbs. com.
Water	1 pint.	5 gallons.

Dissolve the sugar in the water without heating unnecessarily.

The yield from the pint of water will be nearly thirty-five fluidounces, not a quart (thirty-two fluidounces) as formerly stated; to make a quart, fifteen fluidounces of water and a pound and fourteen ounces of sugar should be used. The yield from the larger quantity in the formula, would bear the same proportion, being a fraction over nine and a half gallons.

Syrupus Acaciæ. (*Syrup of Gum Arabic.*) U. S. P.

Take of Gum Arabic, in pieces, two troyounces.
Sugar, in coarse powder (15½ oz. com.), fourteen troyounces.
Water, eight fluidounces.

Dissolve the gum Arabic in the water, without heat; then the sugar with a gentle heat, and strain.

Syrupus Acidi Citrici. (*Syrup of Citric Acid.*) U. S. P.

Take of Citric acid, in fine powder, one hundred and twenty grains.
Oil of lemons, four minims.
Syrup, two pints.

Rub the citric acid and oil of lemon with a fluidounce of the syrup; then add the mixture to the remainder of the syrup, and dissolve with a gentle heat.

Syrupus Allii. (*Syrup of Garlic.*) U. S. P.

Take of Garlic, sliced and bruised, six troyounces.
Sugar, in coarse powder (1 lb. 10 oz. com.), twenty-four troyounces.
Diluted acetic acid, a pint.

Macerate the garlic with ten fluidounces of the diluted acetic acid, in a glass vessel, for four days, and express the liquid. Then mix the residue with the remainder of the acid, and again express until sufficient additional liquid has been obtained to make the whole, when filtered, measure a pint. Lastly, introduce the sugar into a two-pint bottle, pour upon it the filtered liquid; and agitate until it is dissolved.

Syrupus Amygdalæ. (*Syrup of Almond.*) U. S. P.

Take of Sweet almond, twelve troyounces.
Bitter almond, four troyounces.
Sugar, in coarse powder (4 lbs. 15 oz. com.), seventy-two troyounces.
Water, three pints.

Having blanched* the almonds, rub them in a mortar to a very fine paste, adding, during the trituration, three fluidounces of the water and twelve troyounces of the sugar. Mix the paste thoroughly with the remainder of the water, strain with strong expression, add to the strained liquid the remainder of the sugar, and dissolve it with the aid of a gentle heat. Lastly, strain the solution through muslin, and, having allowed to cool, keep it in well-stopped bottles in a cool place.

Syrupus Aurantii Corticis. (*Syrup of Orange-Peel.*) U. S. P.

Take of Sweet orange-peel, recently dried, and in moderately fine powder, two troyounces.
Carbonate of magnesium, half a troyounce.
Sugar, in coarse powder (1 lb. 14½ oz. com.), twenty-eight troyounces.
Alcohol,
Water, each, a sufficient quantity.

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* Almonds are to be blanched by pouring hot water over them and permitting them to remain till the skin is soft, when a slight squeeze between the thumb and finger will cause the almond to slip out of the skin; no unnecessary heat should be used, nor should it be continued longer than is required to soften the skin.

Moisten the orange-peel with half a fluidounce of alcohol, introduce it into a conical percolator, and pour alcohol upon it until six fluidounces of tincture have passed. Evaporate this, at a temperature not exceeding 120°, to two fluidounces, add the carbonate of magnesium and a troyounce of the sugar, and rub them together, gradually adding half a pint of water during the trituration. Then filter, and, having added sufficient water to make the liquid measure a pint, dissolve in it the remainder of the sugar with the aid of a gentle heat, and strain.

Syrupus Aurantii Florum. (*Syrup of Orange Flowers.*) U. S. P.

Take of Orange-flower water, twenty fluidounces.
Sugar (in coarse powder), thirty-six troyounces.

Dissolve the sugar in the orange-flower water, with the aid of a gentle heat.

Syrupus Ferri Iodidi, U. S. P.

Take of Iodine, two troyounces.
Iron, in the form of wire, and cut in small pieces, three hundred grains.
Distilled water, three fluidounces.
Syrup, a sufficient quantity.

Mix the iodine, iron, and distilled water in a flask of thin glass, shake the mixture occasionally until reaction ceases and the solution has a green color and has lost the smell of iodine. Then, having introduced the pint of syrup into a graduated bottle, heat it by means of a water-bath to 212°, and through a small funnel inserted in the mouth of the bottle, and reaching below the surface of the syrup, filter into it the solution already prepared. When this has passed, close the bottle, shake it thoroughly, and when the liquid has cooled, add sufficient syrup to make the whole measure twenty fluidounces. Lastly, again shake the bottle and transfer the contents to two ounce vials, which must be well stopped.

Syrupus Ipecacuanhæ. (*Syrup of Ipecacuanha.*) U. S. P.

Take of Fluid extract of ipecacuanha, two fluidounces.
Syrup, thirty fluidounces.

Mix them.

Syrupus Krameriæ. (*Syrup of Rhatany.*) U. S. P.

Take of Rhatany, in moderately fine powder, twelve troyounces.
Sugar, in coarse powder (2 lbs. 1 oz. com.), thirty troyounces.
Water, a sufficient quantity.

Mix the rhatany with half a pint of water, and, having allowed the mixture to stand for two hours, introduce it into a glass percolator and gradually pour water upon it until four pints of filtered liquid are obtained. Evaporate this, by means of a water-bath, to seventeen fluidounces, and having added the sugar, dissolve it with the aid of a gentle heat, and strain the solution while hot.

This syrup may also be prepared in the following manner:—

Take of Fluid extract of rhatany, twelve fluidounces.
Syrup, twenty-four fluidounces.

Mix them.

Syrupus Lactucarii. (*Syrup of Lactucarium.*) U. S. P.

Take of Lactucarium, a troyounce.
Syrup, fourteen fluidounces.
Diluted alcohol, a sufficient quantity.

Rub the lactucarium with sufficient diluted alcohol, gradually added, to bring it to a syrupy consistence. Then introduce it into a conical percolator, and, having carefully covered the surface with a piece of muslin, gradually pour diluted alcohol upon it until half a pint of tincture has passed. Evaporate this, by means of a water-bath, at a temperature not exceeding 160°, to two fluidounces, mix it with the syrup, previously heated, and strain while hot.

Syrupus Limonis. (*Syrup of Lemon.*) U. S. P.

Take of Lemon juice, recently expressed and strained, a pint.
Sugar, in coarse powder (3 lbs. 5 oz. com.), forty-eight troyounces.
Water, a pint.

Mix the lemon juice and water, and, having added the sugar to the mixture, dissolve it with the aid of a gentle heat, and strain the solution while hot.

Syrupus Pruni Virginianæ. (*Syrup of Wild Cherry Bark.*) U. S. P.

Take of Wild cherry bark, in coarse powder, five troyounces.
Sugar, in coarse powder (1 lb. 14½ oz. com.), twenty-eight troyounces.
Water, a sufficient quantity.

Moisten the bark thoroughly with water, and allow it to stand for twenty-four hours in a close vessel; then pack it firmly in a glass percolator, and gradually pour water upon it until a pint of filtered liquid is obtained. To this, transferred to a bottle, add the sugar, and agitate occasionally until it is dissolved.

Syrupus Rhei. (*Syrup of Rhubarb.*) U. S. P.

Take of Fluid extract of rhubarb, three fluidounces.
Syrup, twenty-nine fluidounces.

Mix them thoroughly.

Syrupus Rhei Aromaticus. (*Aromatic Syrup of Rhubarb.*) U. S. P.

Take of Rhubarb, in moderately fine powder, two troyounces and a half.
Cloves, in moderately fine powder,
Cinnamon, in fine powder, each, half a troyounce.
Nutmeg, in moderately fine powder, one hundred and twenty grains.
Syrup, six pints.
Diluted alcohol, a sufficient quantity.

Mix the powders, and, having moistened the mixture with two

fluidounces of diluted alcohol, introduce it into a conical percolator, and pour diluted alcohol upon it until a pint of tincture has passed. Add this to the syrup, previously heated, and mix them thoroughly.

Syrupus Rosæ Gallicæ. (*Syrup of Red Rose.*) U. S. P.

Take of Red rose, in moderately fine powder, two troyounces.
Sugar, in coarse powder (1 lb. 3½ oz. com.), eighteen troyounces.
Diluted alcohol,
Water, each, a sufficient quantity.

Moisten the rose with diluted alcohol, pack it firmly in a conical glass percolator, and gradually pour diluted alcohol upon it until a fluidounce of tincture has passed. Set this aside, and continue the percolation until five fluidounces more of tincture are obtained. Evaporate this with a gentle heat to a fluidounce and a half, and mix it with seven fluidounces of water. Then, having added the sugar, dissolve it with the aid of a gentle heat, and strain the solution while hot. Lastly, when the solution is cold, add the fluidounce of reserved tincture, and mix them thoroughly.

Syrupus Rubi. (*Syrup of Blackberry Root.*) U. S. P.

Take of Fluid extract of blackberry, half a pint.
Syrup, a pint and a half.

Mix them.

Syrupus Sarsaparillæ Compositus. (*Compound Syrup of Sarsaparilla.*) U. S. P.

Take of Sarsaparilla, in moderately coarse powder (1 lb. 10 ozs. com.), twenty-four troyounces.
Guaiacum wood, in moderately coarse powder, three troyounces.
Pale rose, in moderately fine powder
Senna, in moderately fine powder,
Liquorice root, in moderately fine powder, each, two troyounces.
Oil of sassafras,
Oil of anise, each, five minims.
Oil of gaultheria, three minims.
Sugar, in coarse powder (6 lbs. 9 oz. com.), ninety-six troyounces.
Water, a pint.
Diluted alcohol, a sufficient quantity.

Mix the solid ingredients, except the sugar, with three pints of diluted alcohol, and allow the mixture to stand for four days; then transfer it to a cylindrical percolator, and gradually pour diluted alcohol upon it until six pints of tincture have passed. Evaporate this, by means of a water-bath, to three pints, add the water, filter, and add the sugar, dissolve it with the aid of heat, and strain the solution while hot. Lastly, rub the oils with a small portion of the solution, and mix them thoroughly with the remainder.

Syrupus Scillæ. (*Syrup of Squill.*) U. S. P.

Take of Vinegar of squill, a pint.
Sugar, in coarse powder (1 lb. 10 ozs. com.), twenty-four troyounces.

Dissolve the sugar in the vinegar of squill, with the aid of a gentle heat, and strain the solution while hot.

Syrupus Scillæ Compositus. (*Compound Syrup of Squill.*) U. S. P.

Take of Squill, in moderately coarse powder,
Seneka, in moderately fine powder, each, four troyounces.
Tartrate of antimony and potassium, forty-eight grains.
Sugar, in coarse powder (2 lbs. 14 oz. com.), forty-two troyounces.
Diluted alcohol,
Water, each, a sufficient quantity.

Mix the squill and seneka, and, having moistened the mixture with half a pint of diluted alcohol, allow it to stand for four days. Then transfer it to a conical percolator, and pour diluted alcohol upon it until three pints of tincture have passed. Boil this for a few minutes, evaporate it by means of a water-bath to a pint, add fourteen fluidounces of boiling water, and filter. Dissolve the sugar in the filtered liquid, and, having heated the solution to the boiling point, strain it while hot. Then dissolve the tartrate of antimony and potassium in the solution while still hot, and add sufficient boiling water, through the strainer, to make it measure three pints. Lastly, mix the whole thoroughly together.

Syrupus Senegæ. (*Syrup of Seneka.*) U. S. P.

Take of Seneka, in moderately fine powder, four troyounces.
Sugar, in coarse powder (1 lb. ½ oz. com.), fifteen troyounces.
Diluted alcohol, two pints.

Moisten the seneka with two fluidounces of the diluted alcohol; then transfer it to a conical percolator, and gradually pour on it the remainder of the diluted alcohol. When the tincture has ceased to pass, evaporate it, by means of a water-bath, at a temperature not exceeding 160°, to half a pint; then filter, and, having added the sugar, dissolve it with the aid of a gentle heat, and strain the solution while hot.

Syrupus Tolutanus. (*Syrup of Tolu.*) U. S. P.

Take of Tincture of Tolu, two fluidounces.
Carbonate of magnesium, one hundred and twenty grains.
Sugar, in coarse powder (1 lb. 12½ oz. com.), twenty-six troyounces.
Water, a pint.

Rub the tincture of Tolu first with the carbonate of magnesium and two troyounces of the sugar, then with the water, gradually added, and filter. To the filtered liquid add the remainder of the sugar, and, having dissolved it with the aid of a gentle heat, strain the solution while hot.

Syrupus Zingiberis. (*Syrup of Ginger.*) U. S. P.

Take of Fluid extract of ginger, a fluidounce.
Carbonate of magnesium, one hundred and sixty grains.
Sugar, in coarse powder, seventy-two troyounces.
Water, forty-two fluidounces.

Rub up the fluid extract of ginger first with the carbonate of magnesium and two troyounces of sugar, and then with the water

gradually added, and filter. To the filtered liquid add the remainder of the sugar, and, having dissolved it with the aid of a gentle heat, strain the solution while hot.

Unofficinal Syrups.

Syrup of Chamomile. (*Syrupus Anthemidis.*)

Take of	Chamomile flowers, in coarse powder	One troyounce.
	Cold water	Twelve fluidounces.
	Refined sugar, in coarse powder . .	Twenty ounces.

Make an infusion by displacement of the chamomile flowers and water, remove the residue from the apparatus, and place the coarsely powdered sugar in its stead; on this pour the infusion until it is entirely dissolved.

The foregoing formula by the author was published in the *American Journal of Pharmacy*, vol. xvi. p. 18, and although not an active medicinal agent, has been acceptable to some of the many admirers of chamomile.

The dose might be stated at a tablespoonful.

Syrup of Pipsissewa. (*Syrupus Chimaphilæ.*) (Prof. Procter.)

Take of	Pipsissewa (Chimaphila, *U. S.*) . .	Four troyounces.
	Sugar	Twelve troyounces.
	Water	A sufficient quantity.

Macerate the pipsissewa, finely bruised, in eight fluidounces of water for thirty-six hours, and then subject it to displacement, until one pint of fluid is obtained; reduce this by evaporation to eight fluidounces, add the sugar, and form a syrup in the usual manner.

The long preliminary maceration is rendered necessary by the coriaceous character of the leaves, which impedes their easy exhaustion by the menstruum.

On account of this property, some have preferred boiling them in successive portions of water, mixing the decoctions, evaporating, and, after the sugar has been dissolved, adding a small portion of alcohol, to obviate the proneness to decomposition common to most syrups made in this way.

One fluidounce of this syrup represents two drachms of the leaves. Syrup of pipsissewa is an efficient preparation of one of our most valuable and abundant indigenous tonic and alterative medicines. Dose, a tablespoonful.

Pipsissewa is much used in combination with sarsaparilla and other alteratives, and enters into numerous private recipes of that description.

Syrup of Uva Ursi. (*Syrupus Uvæ Ursi.*) (Duhamel and Procter.)

Take of	Bearberry leaves (Uva Ursi, *U. S.*) .	Four troyounces.
	Water	A sufficient quantity.
	Sugar	One pound.

To the finely bruised uva ursi, add water till it is thoroughly

moistened, then place it in a displacement apparatus, and operate by percolation till it is exhausted of all its soluble active principles; then evaporate to ten fluidounces; add the sugar, and form a syrup, marking 31° Baumé.

The dose of this might be stated as a tablespoonful. Like the foregoing, this syrup is a good preparation of a valuable medicine; the two may often be advantageously associated in diseases of the urinary organs.

Compound Syrup of Carrageen.

Take of Horehound (Marrubium, *U. S.*) . . 1 ounce.
Liverwort (Hepatica, *U. S.*) . . . 6 drachms.
Water . . . . . 4 pints.

Boil for 15 minutes, express, and strain; then add

Carrageen (Chondrus, *U. S.*) . . . 6 drachms,

previously well washed with cold water. Boil again for 15 or 20 minutes, strain through flannel, and add

Sugar, 1 lb. (commercial) to each pint by measure.

The dose of this agreeable medicine is a teaspoonful occasionally; it is a good demulcent, without sedative effects.

The foregoing recipe has been in use for some twenty years in our establishment, and the syrup has been pretty extensively used as a popular cough medicine. It does not keep well in summer, unless in a cool place.

Compound Syrup of Blackberry Root. (*Syrupus Rubi Comp.*)

Take of Blackberry root, bruised . . . . . 8 troyounces.
Cinnamon,
Cloves, and
Nutmegs, of each . . . . . 3 drachms.
Sugar . . . . . 4 pounds (commercial).
Water . . . . . 4 pints.

Boil the root and the aromatics in the water for one hour; express and strain; then add the sugar, form a syrup, and again strain; then add

French brandy . . . . . 6 fluidounces.
Oil of cloves, and
Oil of cinnamon, of each . . . . . 4 drops.

Dose, from a teaspoonful for a child of two years old, to a tablespoonful for an adult, repeated as occasion requires.

The astringent virtues of blackberry root are almost universally known, and it is much used in the form of decoction and syrup throughout the country, both as a domestic remedy and in regular medical practice. This preparation has been long in use, and has the merit of an aromatic and gently stimulant effect combined with astringency.

Syrup of Sweet Gum Bark. (*Liquidambar Styraciflua.*)

Dr. Charles W. Wright, Professor of Chemistry in the Kentucky School of Medicine, recommends a syrup made from the bark of *liquidambar styraciflua*, or sweet gum tree of our forests, as a remedy in the diarrhœa so prevalent among children in our large cities in hot weather, and which frequently terminates in cholera infantum. His formula is that of the officinal syrup of wild cherry, merely substituting one bark for the other. The advantage claimed for it is that of being retained by an irritable stomach when almost every other form of astringent medicine is rejected; the taste is very agreeable. The dose for an adult is a fluidounce after each operation of the bowels; children may take from a fluidrachm to half a fluidounce.

Syrup of Frostwort. (*Syrupus Helianthemi.*)

Take of	Frostwort (the herb)	4 ounces.
	Water, and	
	Alcohol, of each	A sufficient quantity.
	Sugar	16 ounces.

Macerate the bruised herb in eight fluidounces of diluted alcohol, for twenty-four hours; percolate with a mixture of one part of alcohol to three of water, till the liquid comes over nearly free from the taste and color of the plant; then evaporate to one pint, add the sugar, boil for a minute or two, and strain.

Rock rose, frostwort, and frost weed are common synonyms of the herb which is officinal in the secondary list of the *Pharmacopœia* as helianthemum, the herb of helianthemum Canadense; but more familiarly known as cistus Canadensis, the name given to it by some botanists.

Having for some years prepared a syrup of this plant, which was used with success by my brother, the late Dr. Isaac Parrish, in scrofulous affections of the eyes, and also by several other practitioners in diseases of the scrofulous type, I insert the formula as above for the information of such as are disposed to make a trial of this valuable indigenous alterative.

The dose of this syrup is a fluidrachm three times a day.

Syrup of Bittersweet. (*Syrupus Dulcamaræ.*)

Take of	Bittersweet, coarsely powdered	4 ounces.
	Water	12 ounces.
	Alcohol	4 fluidounces.

Mix the liquids, and having moistened the bittersweet with six fluidounces of the menstruum, set it aside for four days, then pack it in a displacer, pour on the powder menstruum sufficient to obtain one pint of tincture, using water to displace the mixed alcohol and water; evaporate to half a pint, add fifteen ounces of sugar, and make a syrup. Dose, a tablespoonful.

This recipe furnishes a syrup which is adapted to use by itself, or in combination with those of sarsaparilla and other alteratives in cutaneous and rheumatic diseases.

Syrup of Gillenia.

Take of	Gillenia (root)	℥ij.
	Diluted alcohol	Oj.
	Sugar	Thirty troyounces.
	Water	Sufficient.

Reduce the gillenia to coarse powder, treat it by displacement with diluted alcohol till Oj is obtained. Evaporate to f℥vj, filter, and add sufficient water to make the liquid measure Oj, then add the sugar and dissolve by the aid of heat.

This syrup has the same proportion of the medicinal ingredient contained in syrup of ipecacuanha, which it resembles in properties, though less agreeable to the taste. The dose is f℥j.

The high price which ipecacuanha has so long sustained has led to inquiries for a good substitute growing on our own soil, and always attainable. "Gillenia trifoliata," Indian physic, is a common indigenous herb, the root of which has long been known to possess very decided nauseant and emetic properties. It cannot be claimed for it that it is identical with ipecacuanha in therapeutical action, although sufficiently allied to it to be used in many cases, particularly of catarrhal affections, as a substitute. The foregoing syrup I have contrived with a view to remove one of the chief objections on the part of the physician to the trial of indigenous drugs, namely, the absence of suitable preparations. As far as it has yet been used, it gives promise of answering a good purpose.

Williams' Sarsaparilla Syrup.

This preparation was much prescribed by the late Dr. J. K. Mitchell, who furnished the following formula:—

Take of	Compound syrup of sarsaparilla	Oj.
	Corrosive chloride of mercury	gr. ij.
	Extract of conium	℥j.

Triturate the corrosive chloride with a little alcohol and water till dissolved, then incorporate it and the extract of conium with the syrup.

Dose, a tablespoonful.

Syrup of Assafœtida. (R. Peltz.)

The object of this formula is to furnish a preparation of assafœtida, free from alcoholic stimulus, and yet tolerably permanent. Although an old specimen of this syrup has a more fetid odor than a recent one, yet the change takes place much less rapidly, and to a less extent, than in the case of the milk or mixture of assafœtida, for which it may be substituted by the physician when it is not convenient to prepare the former:—

Take of	Assafœtida	One ounce.
	Boiling water	One pint.
	Sugar	Two pounds.

Rub the assafœtida with part of the boiling water, till a uniform paste is made; then gradually add the rest of the water, strain, and

add the sugar, applying a gentle heat to dissolve it. Dose, a tablespoonful, containing seven grains and a half (15 grains to the fluidounce) of assafœtida.

By adding one part of tincture of assafœtida to four parts of syrup, and evaporating off the alcohol, a substitute for the foregoing may be prepared.

Syrup of Poppies. (*Syrupus Papaveris.*)

Take of Poppy heads	16 ounces.
Diluted alcohol	4 pints.
Sugar	30 ounces.

Deprive the poppy-heads of their seeds; bruise them thoroughly, macerate them in twice their weight of diluted alcohol for two days, express powerfully, add the remainder of the diluted alcohol, and after twenty-four hours again express; evaporate the liquid to one pint, strain, and add the sugar, and dissolve by the aid of a gentle heat.

This syrup, which, as usually prepared, is extremely liable to ferment, and on that account is a very troublesome preparation to apothecaries who have occasional calls for it, may be conveniently made by the above process of Professor Procter, so as to be permanent.

The proportion of the capsules, though somewhat smaller in this than in the formula of the *London Pharmacopœia*, is larger than those of most of the continental authorities; the dose may be stated to be from a fluidrachm to a half fluidounce. There is considerable difference in the strength of this syrup, if the weight of the capsules is taken before the removal of the seeds, as implied in this recipe, instead of afterwards, as implied in the recipe of the London College. The London College directs its preparation with boiling water, and the subsequent addition of alcohol to prevent fermentation, a very inferior process to that recommended above.

Dorvault recommends the syrup of poppies to be prepared by dissolving half a troyounce of extract of poppies in eight troyounces of water, filtering, and adding this solution to fifty troyounces of simple syrup, and evaporating to fifty troyounces weight.

Syrup of Sulphate of Morphia.

I believe there is no published recipe for this except one that is given in *Griffith's Formulary*, credited to Cadet, which prescribes one grain of the salt to four fluidounces of syrup. Under the head of Syrup of Poppies, in the *U. S. Dispensatory*, Dr. Wood suggests the use of a syrup made by dissolving four grains of the sulphate of morphia in a pint of syrup (a quarter of a grain to the ounce, the same as Cadet's) as a substitute for the syrup of poppies, which, made by the old recipe, is so prone to ferment.

Notwithstanding that we have no officinal or other recognized recipe (that of Cadet being almost unknown in this country), physicians frequently prescribe syrupus morphiæ sulphatis, and generally,

as far as I have inquired, under the impression that there is a syrup corresponding in strength with the officinal liquor morphiæ sulphatis, one grain to the ounce, and hence the habit has grown up with apothecaries of making this preparation extemporaneously of that strength.

This is more remarkable, from the fact that the syrups of acetate and muriate of morphia of the *Dublin Pharmacopœia* are in the proportion of one grain to four fluidounces.

This discrepancy in practice cannot, I think, be remedied by the further publication of unauthorized recipes, and physicians should not fail to indicate the proportions designed in prescribing the salt in solution in syrup. Should there not be an officinal preparation with such a distinctive name and authorized proportions as would remedy so serious a departure from uniformity?

Jackson's Pectoral Syrup.

Alfred B. Taylor, in the *American Journal of Pharmacy*, vol. xxiv. p. 34, holds the following language:—

"A prescription of Prof. Samuel Jackson, of Philadelphia, familiarly known as his 'pectoral syrup,' has obtained considerable reputation from its beneficial action in cases of coughs, colds, etc. We believe the prescription was originally given to Mr. E. Durand, but as the syrup has for some time been a standing preparation with many of our druggists, we have thought that a published formula would be acceptable both for the purpose of giving its benefit to those who may not be familiar with its composition, and of promoting uniformity among those who may already be accustomed to prepare it. Dr. Jackson has furnished us with the following recipe:—

Take of Sassaf. medullæ	℥j.
Acaciæ	℥j.
Sacchari	℔j ¾.
Morphiæ muriat	gr. viij.
Aquæ	Oj. or q. s.

"The sassafras pith and gum Arabic are to be put into the water and allowed to stand ten or twelve hours with occasional stirring. The sugar is to be dissolved, cold, in the mucilage, which, after being strained, should be made to measure two pints by the addition of water; lastly, the muriate of morphia is to be dissolved in the syrup."

In one recipe which has been used for a number of years, half a grain of sulphate of morphia is prescribed, in place of a quarter of a grain, to the ounce, as in the above, and to this is added about half a drachm of Hoffmann's anodyne, and a drop of oil of sassafras to each pint.

A recipe used by some pharmacists is as follows:—

Take of Syrup of gum Arabic	One pint.
Muriate of morphia	Four grains.
Oil of sassafras	Four drops.

Mix.

The adult dose of this syrup is a teaspoonful.

Aubergier's Syrup of Lactucarium.

The recipe of Aubergier contains 45 grains of extract of "English" lactucarium, 15 grains of citric acid, and sufficient boiling water with the proper proportion of sugar, and sufficient orange-flower water to flavor it, to constitute one pint of syrup. It is, however, a very mild preparation, the extract being very partially soluble in the citric acid and water, so that scarcely half a grain of lactucarium is contained in the teaspoonful. The new officinal *syrupus lactucarii*, on the contrary, is a comparatively strong preparation, which would be very unsuitable to dispense when Aubergier's is called for. The fluid extract of lactucarium, described in the chapter on that class of preparations, was originally prepared by W. C. Bakes and myself (see *Amer. Journ. of Pharm.*, 1860, p. 225) for the purpose of making a substitute for Aubergier's syrup and for tincture of lactucarium; the following is the modified formula for the syrup:—

Take of	Fluid ext. of (English) lactucarium . .	A fluidrachm.
	Sugar	Two pounds (com.).
	Water	One pint.
	Syrup of orange-flower	Four fluidounces.

Triturate the fluid extract with a portion of the sugar, dissolve this and the remainder of the sugar in the water by the aid of heat, strain, and add the syrup of orange-flower.

To those having the officinal syrup prepared, the following formula may be a convenience in preparing a modified Aubergier's:—

Take of	Syrup of lactucarium, *U. S. P.*	1 part.
	Simple syrup	10 parts.
	Syrup of orange-flower	4 parts.

Mix them.

This is a mild expectorant and sedative preparation, given in doses of a teaspoonful to a tablespoonful.

A more efficient syrup of lactucarium may be readily prepared as follows:—

Take of	Fluid extract of lactucarium	f℥j.
	Glycerin	f℥j.
	Sugar	Six troyounces.
	Stronger alcohol	f℥ij.

Rub the lactucarium with 1 oz. sugar; then add very gradually with trituration f℥vj of water, and filter; pass water through the filter till fourteen fluidrachms have been obtained, to which add f℥ij of alcohol; then mix with syrup made by dissolving five troyounces of sugar with two fluidounces of water and a fluidounce of glycerin.

Syrup of Manna. (*Syrupus Mannæ.*)

This is often directed by practitioners, without a very clear idea of what they are prescribing, since neither of the British *Pharmacopœias* nor our own contains any mention of it. The following

recipe, taken from the *Pharmacopée Universelle*, I have used with satisfactory results:—

Take of Flake manna	Ten ounces.
Water	Twelve ounces.

Make a solution, strain, and add

Sugar	One pound (com.).

Which dissolve by the aid of heat.

This is an elegant laxative, where not contraindicated by debility of the digestive organs, and is chiefly prescribed for children and parturient women.

When extemporaneously prepared, there seems no necessity of adding the sugar at all, as a simple solution of manna in water is sufficiently agreeable, besides being stronger than the above. The peculiar sugar of manna is not fermentable.

Syrupus Gallæ. (*Syrup of Galls. Aromatic Syrup of Galls.*)

This old and esteemed recipe is attributed to several eminent physicians of the last generation. It is used in chronic diarrhœa, and obstinate cases of dysentery.

Take of Bruised galls	℥ss.
Brandy	f℥viij.

Introduce into an f℥viij vial, digest in hot water for half an hour, and filter; then pour it into a saucer, and inflame the spirit with a lighted taper; add sugar ℥ij, by melting it in the flame on a fine wire support, and allowing it to drop into the brandy, which must be stirred till it ceases to burn, and a syrup is formed. Then introduce it again into the f℥viij vial, and fill it up with water.

Some recipes direct that cinnamon and mace, of each ℥ij, shall be digested in the brandy, which is an improvement on the foregoing. Dose, a teaspoonful to a tablespoonful; for infants from 10 to 20 drops.

Syrup of Lacto-phosphate of Lime.

Take of Precipitated phosphate of lime	℥iv.

Dissolve in f℥vj of muriatic acid diluted with f℥xvj of water; precipitate with sufficient water of ammonia. Wash rapidly on a filter, press out the excess of water, and add f℥iv of concentrated lactic acid; when dissolved, add f℥xl of distilled water and 54 oz. (avoir.) of sugar; dissolve the sugar without heat and add f℥x of orange-flower water. Let the finished syrup be made up to 80 fluidounces by the addition of water.

This syrup has been much prescribed in cases where the phosphatic lime salt is indicated.

Mellita. Honeys.

The officinal class *Mellita* differs from the syrups in being made with honey, a mixed saccharine product described in Part IV. They are only three in number, as follows:—

Mel Despumatum. (*Clarified Honey.*) U. S. P.

Take of Honey, a convenient quantity.

Melt it by means of a water-bath, and then remove the scum.

Mel Rosæ. (*Honey of Rose.*) U. S. P.

Take of Red rose, in moderately fine powder, two troyounces.
Clarified honey, twenty-five troyounces.
Diluted alcohol, a sufficient quantity.

Moisten the powder with half a fluidounce of diluted alcohol, pack it firmly in a conical glass percolator, and gradually pour diluted alcohol upon it until six fluidrachms of filtered liquid have passed. Set this aside, and continue the percolation until half a pint more of liquid is obtained. Evaporate this, by means of a water-bath, to ten fluidrachms, add the reserved liquid, and mix the whole with clarified honey.

Mel Sodii Boratis. (*Honey of Borax.*) U. S. P.

Take of Borate of sodium, in fine powder, sixty grains.
Clarified honey, a troyounce.

Mix them.

The uses of these will be apparent. *Honey of rose* is an elegant astringent adapted to relieve diseased conditions of the throat and fauces, as an adjuvant to gargles, mouth washes, etc. *Honey of borax* has similar uses, and is especially efficient in the sore mouth of infants. The peculiar adhesiveness of honey adapts it to these purposes better than sugar.

Oxymel of squill, officinal in the previous editions of the *Pharmacopœia*, was dismissed from that of 1860. It consists of two pints of vinegar of squill to one and a half pints of honey, evaporated to the sp. gr. of 1.32.

Simple oxymel, formerly officinal in the British Colleges, consists of mixtures of acetic acid, water, and honey.

Citromels and tartromels are solutions of citric and tartaric acid in honey, with the aid of a small proportion of water; they have been proposed as vehicles for iodide of iron, which these vegetable acids are said to aid in preserving from decomposition. The use of honey with vegetable acids is preferred over cane sugar on account of the liability of the latter to pass into grape sugar in contact with acids.

GLYCERITA, *U. S. P.* GLYCERITES. (GLYCERINA, *Ph. Br.* GLYCERINES.)

Glyceritum Acidi Carbolici, U. S. P. (*Glycerite of Carbolic Acid.*)

Take of Carbolic acid . . . . . Two troyounces.
Glycerin . . . . . Half a pint.

Rub them together in a mortar, until the acid is dissolved.

Glyceritum Acidi Gallici, U. S. P. (*Glycerite of Gallic acid.*)

Take of Gallic acid . . . . . Two troyounces.
Glycerin . . . . . Half a pint.

Rub them together in a mortar; then transfer to a glass or porcelain capsule, and heat gently until the acid is dissolved.

Glyceritum Acidi Tannici, U. S. P. (*Glycerite of Tannic Acid.*)

Take of	Tannin	Two troyounces.
	Glycerin	Half a pint.

Rub them together in a mortar; then transfer them to a glass or porcelain capsule and heat gently until the acid is dissolved.

Glyceritum Picis Liquidæ, U. S. P. (*Glycerite of Tar.*)

Take of	Tar	A troyounce.
	Carbonate of magnesium, in powder	Two troyounces.
	Glycerin	Four fluidounces.
	Alcohol	Two fluidounces.
	Water	Ten fluidounces.

Having mixed the glycerin, alcohol, and water, rub the tar in a mortar, first with the carbonate of magnesium and then with six fluidounces of the mixed liquids gradually added, and strain with expression. Rub the residue in like manner with half the remaining liquid, and strain as before. Repeat the process again with the remaining liquid. Put the residue into a percolator, add gradually the expressed liquids previously mixed, and afterwards a sufficient quantity of water to make the liquid which passes measure a pint.

Glyceritum Sodii Boratis, U. S. P. (*Glycerite of Borate of Sodium.*)

Take of	Borate of sodium, in powder	Two troyounces.
	Glycerin	Half a pint.

Rub them together in a mortar, until the borate of sodium is dissolved.

This class was made officinal at the late revision of the *Pharmacopœia*. The numerous purposes to which glycerin has been found applicable, and its ready miscibility with aqueous preparations, have rendered it important that some authoritative standard should be had for preparations of this class. The great reduction in the price of glycerin renders its introduction much more easy than it would have been a few years since. (For remarks respecting the nomenclature of this class of preparations, see 13th edition of *U. S. Dispensatory*, page 1197.)

This class succeeds that formerly termed glyceroles, which are preparations in which glycerin is used in the place of other antiseptics, wholly or chiefly, in the preparation of remedies for internal use. In England they were called glycerides; those used externally are called plasma, liniments, lotions, etc., mentioned among the topical remedies. Of those used internally, one or two will be found among the chemical remedies. The special uses of glycerin in pharmacy are, *First*, as a solvent, in which capacity it

has very numerous applications. *Second*, as an antiseptic, for which it is well adapted. *Third*, as an emollient in irritable and inflammatory conditions of the mucous surface and in skin diseases; and *fourth*, as a bland nutritive material to replace oils and fats. The chief objections to its use are founded on its comparatively high price, and the fact that the glyceroles are not usually as agreeable in taste as corresponding syrups.

The solvent powder of glycerin is, in general, between that of water and alcohol, and generally substances may be said to be more soluble in glycerin, the more they are so in alcohol. A high temperature greatly increases its solvent power.

Glycerole of Lactucarium. (F. Stearns.)

Take of Lactucarium	One ounce.
Diluted alcohol,	
Boiling water, each	Sufficient.
Glycerin	Twelve fluidounces.
Citric acid	Fifteen grains.
Orange-flower water	Two fluidounces.

Reduce the lactucarium to a moderately fine powder; moisten with one fluidounce of diluted alcohol and pack into a small displacer. After macerating twelve hours, pour upon it gradually diluted alcohol until the filtrate measures sixteen fluidounces, or until it passes without taste. Evaporate this on a water-bath nearly to dryness, then boil this residue with six fluidounces of water; pour this off from the undissolved residue into a filter placed over a bottle containing the glycerin; add four fluidounces of water to the undissolved residue, boil, and filter into the first portion. Then evaporate the whole on a water-bath to fourteen fluidounces, and, when cool, add the orange-flower water in which the citric acid has been previously dissolved. Each fluidounce represents a half drachm of lactucarium. DOSE, one to three teaspoonfuls.

Glycerole of Sumach. (W. C. Bakes.)

Take of Sumach berries	Sixteen troyounces.
Boiling water	Three pints.

Macerate the sumach for an hour and a half, then express strongly, and add another pint of boiling water to the mass and express again. Mix the infusions and evaporate to eight fluidounces, then add glycerin sufficient to make the whole measure one pint, and filter.

FLAVORING SYRUPS USED CHIEFLY IN CONNECTION WITH "MINERAL WATER" AND OTHER BEVERAGES.

Lemon Syrup.

This is now almost universally made from citric or tartaric acid and oil of lemon, instead of lemon juice. Some of the confectioners, when they are overstocked with lemons, make them into syrup, but from the use of fruit that has partially spoiled, and from the syrup being made in such large quantities at once as to become

more or less altered by keeping, before it is consumed, the article thus made is inferior to that made from acid and oil of lemon. A very fine flavoring syrup may, however, be made by using fresh lemons and making the syrup in small quantities, by the *Pharmacopœia* process.

Citric acid is preferable to tartaric for preparing the syrup; when made with the former acid it has a more agreeable flavor, which it retains longer unimpaired. The syrup made with either acid, when longer kept, is liable to throw down a white granular deposit of grape sugar. A "turpentine taste" is very common in the lemon syrup which is manufactured and sold wholesale, and may frequently be due to the employment of old or impure oil of lemon. A common adulteration of this oil is the admixture of recently distilled oil of turpentine or camphene, and the adulterated oil may contain a considerable portion of it without its being perceptible by taste or odor while new, but as the camphene becomes resinous, the turpentine flavor is developed. But even pure oil of lemon degenerates in flavor and odor when long kept; therefore, it is better to prepare the syrup in small quantities, so that it will be consumed before there is any change in its quality.

A more delicate flavor of the lemon may be obtained by macerating the outer portion of lemon-peel in deodorized alcohol, allowing this to evaporate spontaneously, and, when it is nearly all dissipated, adding it to sugar to be incorporated with the syrup, or triturating with magnesia, adding water, filtering, and making a syrup; as directed in the officinal process for syrup of orange-peel.

The simple syrup used as a basis of these flavoring syrups may be made by the process given on page 703, or may contain a less proportion of sugar, say *seven avoirdupois pounds* to half a gallon of water. The lemon syrup will then be made easily, as follows:—

Take of	Oil of lemon	20 drops.
	Citric acid	An ounce.
	Simple syrup	One gallon.

Rub the oil of lemon with a little sugar and afterwards with a portion of syrup, and having dissolved the acid in a gill of water mix the whole thoroughly together. The addition to this, and to ginger, orange, and capsicum syrups of a little syrup of gum Arabic promotes their frothing.

Lemonade may be made, of good quality, by mixing one pint of this syrup with two gallons of iced water, stirring thoroughly.

Orange Syrup.

1*st Process.*—

Take of	Syrup of orange-peel, *U. S. P.*	One pint.
	Citric acid	45 grains.

Dissolve the acid in the syrup.

2*d Process.*—Take of oranges, the fresh fruit, a convenient number, grate off the yellow outside peel, cut the oranges and express the juice, to each quart of which add

Water	1 pint.
Sugar	6 lbs. (com.).

Mix the sugar with the grated peel, add the mixed water and juice, and apply a gentle heat till it is dissolved, then strain.

One dozen oranges will make one and a half to two gallons of syrup.

If a pure and fresh article of oil of orange can be obtained, the syrup may be made by the following formula:—

3d Process.—

Take of	Syrup	2 pints.
	Oil of orange	5 minims.
	Citric acid	1 drachm.

Mix.

Ginger Syrup.

The syrup made by the formulæ of the *Pharmacopœia*, lately revised, is all that can be desired, in the way of a bright, clear syrup, it being of the proper strength for mineral water use.

Some druggists prefer to boil ginger in water, which extracts a large amount of starchy matter, and makes a richer and more frothy mineral-water syrup. The following is the recipe:—

Take of	Ginger, bruised	3 ounces.
	Water	2 pints.

Boil for half an hour in a covered vessel, strain, and add

	Sugar	4 lbs. (com.).

Continue the heat until it is dissolved.

Capsicum Syrup.

Take of	Simple syrup	Two pints.
	Tincture of capsicum	A fluidounce.

Heat the simple syrup, add the tincture, keep heated until the alcohol has evaporated, then mix immediately; care should be taken not to allow the globules of resin of capsicum to separate from the syrup.

This is a fine stimulant, which is used to advantage in mineral water, in intensely hot and debilitating weather, when the relaxed condition of the digestive organs seems to contraindicate the use of cold drinks.

Sarsaparilla Syrup for Mineral Water.

As this syrup is intended for making a pleasant beverage, it is made much weaker of sarsaparilla than the compound syrup of the *Pharmacopœia*, and the senna, guaiac, etc., which enter into the composition of the latter, are very properly omitted.

The following is the formula of Ambrose Smith:—

Take of	Sarsaparilla, finely bruised,	
	Liquorice root, finely bruised, of each	2 lbs. (com.).
	Sugar	30 lbs. (com.).
	Oil of anise, wintergreen, and sassafras, of each	40 drops.
	Oil of cinnamon	5 drops.
	Water	q. s.

Digest the roots 12 hours, with 2 gallons of warm water, then put into a percolator and displace, adding sufficient water until 2

gallons of infusion are obtained. In this dissolve the sugar with the aid of heat, and to the syrup when cooled add the oils, previously rubbed up with a little sugar.

The following formula is employed by some druggists:—

Take of	Sarsaparilla, liquorice root, each	1 lb.
	Cinnamon, sassafras, each	6 oz.
	Cloves, anise, coriander, each	2 oz.
	Red saunders, cochineal, each	1½ oz.
	Alcohol	2 pints.
	Water	2 gallons.

Digest the above for 4 days, strain, and make a syrup with 27 lbs. (com.) of sugar. It is also frequently made by diluting the compound syrup with twice its measure of simple syrup, and adding the essential oils. The fluid extract of sarsaparilla, if mezereon enters into its composition, does not answer, as the persistent acrimony of this bark is so perceptible even in the diluted syrup as to make it unpalatable.

The following is our own formula:—

Take of	Simple syrup	Oij.
	Comp. syrup of sarsap.	f℥ij.
	Caramel	f℥vj.
	Oil of gaultheria, and	
	Oil of sassafras, of each	3 drops.

Mix by shaking up in a bottle.

Orgeat Syrup.

This corresponds with the officinal syrupus amygdalæ (see p. 704), with the addition of some more decided flavoring substance, as orange-flower water, bitter almond oil, or vanilla.

The following formula is sometimes preferred, as requiring less time and trouble in its preparation:—

Take of	Cream syrup,	
	Vanilla syrup, each	1 pint.
	Oil of bitter almonds	4 drops.

Mix well together, observing not to make more than sufficient for one day's sales.

Fruit Syrups.

To make one gallon of strawberry, raspberry, or blackberry syrup:—

Take of	the fresh fruit	4 quarts.
	Water	Sufficient.
	Sugar	8 lbs. (com.).

Express the juice and strain, then add water till it measures four pints; dissolve the sugar in this by the aid of heat, raise it to the boiling point, and strain. If it is to be kept till the following season, it should be poured while hot into dry bottles, filled to the neck, and securely corked.

The clothes-wringer (Fig. 215, page 579) will be found a good press for obtaining the juice from the fruit, which should be first

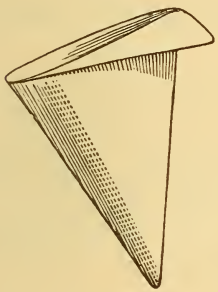
thoroughly mashed into pulp and inclosed in a very strong square canvas bag.

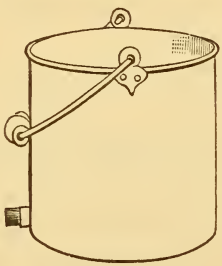
Strawberry syrup is made by inclosing the ripe fruit in a strong bag, then applying pressure by means of a screw or lever press, or between elastic rollers as above; small quantities may be pressed sufficiently by hand. The juice is now diluted, mixed with sugar, and transferred to a kettle, in which it is heated to the boiling point, and then strained while hot.

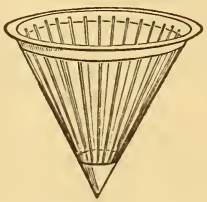
The yield of juice from strawberries is from one-half to one-third the bulk of the berries, and the dilution with water, by the above rule, will be accordingly.

Fig. 234 represents the straining bag; and Figs. 235 and 236 the apparatus for straining and expressing, by means of a square piece of flannel or muslin. The mode of using them will be apparent.

Fig. 234. Fig. 235. Fig. 236.







Another way to prepare this syrup, where a fine and very delicate flavor is desired, is to macerate the ripe berries in layers interspersed with powdered sugar, one and three-quarter pounds of sugar to a pound of the picked berries for twenty-four hours, in a cellar, and then throw them on a sieve or perforated capsule for the syrup to drain off. This juice is to be put into a bottle, loosely corked, set into a vessel of water, and heated to the boiling point; after which it is to be tightly sealed and laid away in a cool place.

Raspberry syrup is made by the same process; the juice is richer in pectin and more liable to glutinize than the foregoing, so that it bears a larger dilution; it improves the flavor of this syrup to use a small proportion of pie cherries, or currants—say a pound to four quarts of the raspberries.

Blackberry syrup does not differ from the other fruit syrups in its mode of preparation, except in the usual addition of a small proportion of French brandy, say a fluidounce to each pint of syrup.

The formula for these three syrups being the same, as the fruits yield variable quantities of juice, the degree of dilution is so regulated that every quart of the fruit will yield a quart of syrup.

Blackberry brandy contains a much larger proportion of brandy and less sugar, with some aromatics.

Aromatic Blackberry Syrup. (Dr. P. B. Goddard.)

Take of Blackberry juice	Oij.
Sugar	℔j.
Nutmegs, grated	No. vj.
Cinnamon, bruised	ʒss.
Cloves	ʒij.
Allspice	ʒij.
Brandy	Oj.

Make into a syrup *secundem artem.*

The astringent properties of blackberry juice adapt it particularly, in combination with carminatives, to the treatment of bowel complaints.

Raspberry Vinegar.

Take of Raspberry syrup	Oij.
Acetic acid	fʒss.

Mix them.

Added to iced water according to taste, this is one of the most delightful of refrigerant drinks.

Take of Raspberry juice	Oijss.
White wine vinegar	Oj.
Sugar	℔s. 6 (com.).

Dissolve the syrup with a gentle heat, and strain, if necessary.

This latter formula yields a much more delicate preparation.

With the object of removing pectin from the juice of fleshy fruits, the *Prussian Pharmacopœia* directs the production of incipient fermentation. The following is a type of the class:—

Cherry Syrup.

Take of fresh sour cherries, a convenient quantity, bruise them with the stones and let them stand for three days, then express the juice and set aside until, after fermentation, it has become clear. To 20 ounces (weight) of this filtered juice add of sugar 36 ounces, and make into a syrup by raising to the boiling point.

The raspberry and other similar juices, as imported into this country from France and Germany, are, or ought to be, the juices prepared in the above way; they are devoid of the mucilaginous principles (pectin, etc.), contain a small quantity of alcohol, and keep well in sealed bottles; exposed to the air, of course they soon undergo acetous fermentation.

Artificial Syrup of Raspberry.

The following formula, though not recommended as a substitute for the true fruit syrup, will be found a tolerable approximation to it:—

Take of Orris root (selected)	1 oz.
Cochineal	2 dr.
Tartaric acid	2 dr.
Water	1 quart.

Powder the orris root coarsely, together with the cochineal, infuse in the water with the acid for twenty-four hours; strain, and add four pounds of sugar; raise to the boiling point and again

strain. A few drops of artificial extract of raspberry (see Part IV.) may be added when cold.

Pineapple Syrup.

Take of the fruit a convenient number, pare them and mash them, without slicing, in a marble or porcelain mortar, express the juice, and take for each quart—

Water	1 pint.
Sugar	6 lbs. (com.).

The water and sugar may be placed on the fire and heated to near the boiling point before adding the juice, after which, continue the heat till the syrup boils, then remove from the fire, skim, and strain. Preserve this as the foregoing.

Vanilla Syrup.

Take of Vanilla	6 drachms.
Boiling water	4½ pints.
Sugar	8 lbs. (com.).

Reduce the vanilla to fine powder by trituration with a portion of sugar, boil this with water two hours in a covered vessel, then strain, and dissolve in it the remainder of the sugar.

Another formula, which is preferable, is—

Take of Fluid extract of vanilla	f℥j.
Syrup	f℥xv.

Mix.

Coffee Syrup.

Take of Roasted coffee	4 oz.
Boiling water	2 pints.
Sugar	4 lbs. (com.).

Digest the coffee in coarse powder in the boiling water, in a covered vessel, filter, or clarify with white of egg, strain, and add the sugar.

Wild Cherry Syrup is a popular and wholesome flavor for mineral water; the officinal article can hardly be improved upon.

Cream Syrups.

These are mixtures of highly flavored syrups with fresh cream. They must be made fresh every few days, and may contain equal parts of their ingredients, or, preferably, two parts of the flavored syrup to one of cream.

Some pharmacists prefer to make syrup of cream, and to flavor this by the addition of strong fruit, and other syrups, in the glass, on drawing the mineral water.

Simple Syrup of Cream.

Take of Fresh cream	1 pint.
Powdered sugar	1 lb. (com.).

Mix and shake well together. To be kept in bottles not exceed-

ing a pint. The formula of A. B. Taylor directs equal parts of cream and milk with the same proportion of sugar. That of O. S. Hubbell directs fourteen pounds of sugar to each gallon of cream.

Nectar Cream is variously made from cream syrup and flavored syrups. The following is a good mixture:—

Take of	Simple syrup of cream	1 part.
	Vanilla syrup	3 parts.
	Pineapple syrup	1 part.
	Lemon syrup	1 part.

Mix.

Hubbell's formula directs the addition of sherry wine, against which objections might be urged as tending to promote a taste for alcoholic stimulants. A great variety of fancy names are given to these combinations of cream syrup with alcoholic and other flavoring ingredients.

Factitious Cream Syrup.

Take of	Ol. amygd. dulcis (recent)	f℥iij.
	Pulv. acaciæ	℥ij.
	Aquæ	℥ix.

M. ft. Emulsio, et adde

	Sacchari albi	℔j.
	Albumen ovi	No. ij.

Dissolve the sugar by a gentle heat, strain, and when cold add the white of egg; fill small bottles and keep in a cool place, well corked. This preparation will keep for a long time. For use, mix one part with eight of any of the ordinary syrups, or add about a drachm to every glass.

It forms an imitation of *orgeat* by mixing two drachms or more with two ounces of simple syrup, and flavoring with bitter almond and orange-flower water.

CHAPTER XIII.

OF CONSERVES, CONFECTIONS, ELECTUARIES, PASTES, LOZENGES, AND CANDIES.

Preparations having pectin as their basis, or containing medicinal substances suspended in a semi-solid form by the aid of honey and syrup, are variously termed Conserves, Electuaries, and Confections.

The officinal class *Pulpæ* of a previous *Pharmacopœia*, consisting of the pulps of prunes, tamarinds, and figs, was dismissed in the revision of 1860, and the class *Confectiones* altered so as to embrace the process formerly included in it.

Confectiones, *U. S. P.*

This class naturally subdivides into two, which are nearly alike in their properties, but quite unlike in their mode of preparation.

1st Class.—*Conserves.*

Confectio Aurantii corticis, *U. S.*, 1 part peel (grated) to 3 sugar.
" *Rosæ* (by an *unofficinal* process), 1 part rose leaf to 3 sugar.
" *Amygdalæ* (*Lond. Ph.*), sweet almonds, gum, and sugar.

By beating with powdered sugar a fresh, moist substance, as undried rose petals, or the rind of a fresh orange, or a fruit rich in oil, and naturally moist, like the almond, we obtain a true conserve. The trituration should be continued till a smooth and uniform firm paste is produced, which will generally be permanent if kept in a well-covered vessel, except in the instance of the almond, which will be rendered unfit for use by long keeping, and hence the confection has been omitted in the recent editions of the *U. S. Pharmacopœia.*

Confection of rose is more frequently made, according to my observation, by the above process, with the common hundred-leaved and damask-rose petals, than by that of the *Pharmacopœia*, in which the powdered red-rose petals are directed to be made into an electuary; so that Confectio Rosæ, as usually met with, is not decidedly astringent.

Confection of orange-peel is made chiefly, as directed by the officinal formula, from the rind of the common sweet orange, so abundant in our market, and not from bitter orange-peel. The proportion is one part of the grated rind to three of sugar.

Confection of almonds is made from the blanched almonds, triturated through a fine sieve, and thoroughly incorporated with the gum and sugar, thus forming the whole into a mass. It furnishes a ready mode of forming almond mixtures.

2d Class.—*Electuaries.*

Confectio Rosæ. Powd. red rose 2 p., sugar 15 p., honey 3 p., rose-water 4 p.
" Aromaticus. Aromatic powder, honey, equal parts.
" Opii (1 gr. in 36). Opium powd., aromatic powd., and honey.
" Sennæ. P. senna and coriander, added to pulp of prunes, figs, tarmarinds, and purging cassia.

All of this division of the confections are made from dried and powdered materials, incorporated mechanically with a saccharine liquid into mass.

Confection of rose is used as a vehicle in the preparation of pills, which is almost its only use; it is directed in the formula for blue pills.

Aromatic confection and *confection of opium* are somewhat used as vehicles; the latter is prescribed in old recipes, and sometimes in prescriptions, as *Theriaca Andronica.* It enters into the composition of a celebrated fever and ague mixture introduced among extemporaneous preparations; it is sometimes called Venice treacle.

Confection of senna is a fine laxative, and, when properly pre-

pared is one of the most agreeable remedies of its class. If given in large enough quantities to purge actively, it is liable to disagree with the stomach when there is a want of tone in that organ, and to become distasteful to the patient.

Confectio Sennæ, U. S. P. (*Confection of Senna. Lenitive Electuary.*)

Take of Senna, in fine powder, eight troyounces.
Coriander, in fine powder, four troyounces.
Purging cassia, finely bruised, sixteen troyounces.
Tamarind, ten troyounces.
Prune, sliced, seven troyounces.
Fig, bruised, twelve troyounces.
Sugar, in coarse powder, thirty troyounces.
Water, a sufficient quantity.

Digest, in a close vessel, by means of a water-bath, the purging cassia, tamarind, prune, and fig in three pints of water for three hours. Separate the coarser portions with the hand, and pass the pulpy mass, by rubbing, first through a coarse hair sieve, and then through a fine one, or a muslin cloth. Mix the residue with a pint of water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy liquid first obtained. Then by means of a water-bath, dissolve the sugar in the pulpy liquid, and evaporate the whole until it weighs eighty-four troyounces, or until it has been brought to the consistence of honey. Lastly, add the senna and coriander and incorporate them thoroughly with the other ingredients while yet warm. The whole should weigh ninety-six troyounces.

Few manufacturers take the trouble to make this preparation in perfection. The above, which is an improved and simplified formula, should induce every pharmacist to make the confection, and by following the formula carefully, and securing a perfectly fine powder of coriander seed, a good preparation will be the result.

Hæmorrhoid Electuary.

The following recipe has been in use for many years as a remedy for piles, and, from the numerous cases in which it has afforded relief, is believed worthy a place among our unofficinal formulas:—

Take of Bitartrate of potassium,
Powdered jalap,
Powdered nitrate of potassium, of each . . Half an ounce.
Confection of senna . . . . . An ounce.

Make an electuary with syrup of ginger.

Dose, a piece the size of a marble three times a day.

Pile Electuary. (Dr. Parrish, Sr.)

Take of Senna, in fine powder . . . . . ℥ij.
Extract of liquorice . . . . . ℥j.
Sulphur . . . . . ℥j.
Rhubarb, in fine powder . . . . . ℥ij.
Ginger . . . . . ℥ij.
Honey, q. s. ft. mass.

Dose, a piece the size of a hazel-nut two or three times a day.

Confection of Black Pepper. (*Ward's Paste.*)

The following is the recipe from the *London Pharmacopœia* for this celebrated preparation, which is not unfrequently prescribed for piles; it is said to require to be used continuously for some months to realize good results:—

Take of			Reduced.
	Black pepper, Elecampane, each	1 pound	℥j.
	Fennel (seeds)	3 pounds	℥iij.
	Honey, Sugar, each	2 pounds	℥ij.

Rub the dry ingredients together into a very fine powder, and keep them in a covered vessel; but, whenever the confection is to be used, add the powder gradually to the honey, and beat them until thoroughly incorporated. Dose, ʒj to ʒij, three times a day.

Pastes.

Medicines having sugar and gum for their basis, of a firm yet flexible consistence, intermediate between confections and lozenges, are called *Pastes*. These are usually sold in sheets, or in small squares, each of which is of suitable size to be taken at one time into the mouth, and covered with powdered sugar, or, in the case of jujube paste, with oil, to prevent their sticking together.

The object proposed in their preparation is the production of an agreeable demulcent and expectorant form of medicine; as their pleasant qualities are to a great extent lost by age, they should be frequently prepared.

The transparent kinds are allowed to cool and harden spontaneously, while the opaque varieties are stirred and beaten as they cool. A few recipes for pastes are appended:—

Jujube Paste. (*Transparent Gum Paste.*)

Take of	Gum Arabic	6 ounces.
	Water	8 fluidounces.

Bruise the gum, and make it into a clear mucilage, which may be conveniently done by inclosing it in a bag of coarse gauze suspended near the top of a vessel of cold water; introduce the mucilage into an evaporating dish, and add—

Syrup . . . . . 7 ounces (by weight).

Evaporate to a very thick consistence, adding, towards the last—

Orange-flower water . . . . . 2 fluidrachms.

Let it cool, remove the crust which will have formed on the surface, and run the paste into shallow tin pans, which lay away in a warm place to dry. In order to turn out the paste, some are in the habit of slightly greasing the pans; but, this oil sometimes becoming rancid and giving unpleasant properties to the paste, it is suggested by Dorvault to make use of tin pans prepared by spreading with a rag a globule of mercury over the whole inside surface, and

then wiping it well. The moulds need to be gone over with the mercury only once in eight or ten times. The *French Codex* directs the addition of a decoction of jujube; but this, which was the original practice, and gave name to the preparation, is now generally abandoned. The use of orange-flower water is generally substituted in this country by oil of lemon or rose, and, where the latter is used, a red color is imparted to the paste for the sake of distinction. Other flavors may be used.

Marshmallow Paste. (*Opaque Gum Paste. Pate de Guimauve.*)

Take of Gum Arabic (white),
Sugar, of each . . . . . ℔j.
Water . . . . . Sufficient.
Orange-flower water . . . . . f℥iij.
White of eggs . . . . . No. x.

Bruise the gum, dissolve it in the water, and strain; put the gummy solution upon the fire in a deep, wide pan, add the sugar, stirring continually until it has the consistence of thick honey, carefully regulating the temperature. Then beat the eggs to a froth, add them and the orange-flower water gradually to the paste, which must be constantly stirred; continue to beat the paste until, in applying it with the spatula upon the back of the hand, it does not adhere to it, then run it out upon a slab, or into pans covered with starch.

Formerly this contained marshmallow; now it is, properly speaking, only an opaque paste of gum.

The *Iceland moss paste*, so extensively advertised of latter years, may be closely imitated by this process, slightly varying the flavor. The asserted presence of *Iceland moss* in it improves it only in name.

Carrageen Paste. (*Mouchon.*)

Take of Carrageen . . . . . ℥j.
Water . . . . . Ovj.

Boil the carrageen (previously soaked) first in four pints, and then in the remainder of the water, and mix the liquids; to this add—

Pure gum Arabic,
Sugar, of each . . . . . 8 ounces.

Strain, evaporate to a very thick consistence, cool it, and separate any crust, and run it out into pans or on a slab.

Iceland Moss Paste. (*French Codex.*)

Take of Iceland moss . . . . . ℥ij.
Gum Arabic . . . . . ℥x.
Sugar . . . . . ℥viij.
Water . . . . . Sufficient.

Wash the Iceland moss in boiling water, and, having rejected this, boil it in an additional portion of water during an hour. Express and strain, add the gum and sugar, and evaporate till a drop does not adhere to the back of the hand; then cool it on a marble slab.

Trochisci.—Lozenges.

The manufacture of lozenges, as of confections, and of some syrups, pertains to the confectioner, in common with the pharmacist, and is principally confined to the former; yet the obvious eligibility of this form of preparation, for certain expectorant and other medicines, particularly for children, makes a knowledge of them desirable both to the physician and pharmacist.

The process for preparing them is quite simple, and so well adapted to all insoluble, tasteless, and agreeable medicines, that we may with propriety resort to it for ordinary purposes in prescribing.

The author has repeatedly made up medicines in this form extemporaneously by physician's prescription, and with considerable advantage, as compared with the usual pharmaceutical forms.

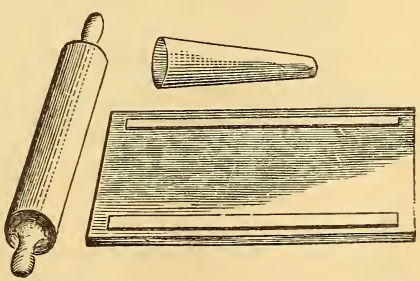
The lozenges to be described are of two varieties.

First.—Those which consist of white sugar combined with a medicinal substance, and made up by the addition of mucilage. The dry ingredients are first to be thoroughly reduced to powder and mixed together; then beaten in a suitable mortar, with sufficient mucilage of tragacanth or gum Arabic to form a tenacious and tolerably firm mass; this mass, being dusted with a little powdered sugar (not starch, which is sometimes used), is to be rolled out upon a suitable board, or marble slab, to the required thickness, previously ascertained; and then, with a small punch, either round, oval, stellate, or cordate, to suit the taste of the maker, cut out singly, and laid away to dry on a suitable tray or sieve.

A manufacturer of great experience informed the editor that he had found a steel roller turned perfectly true, and a slab with supporting strips made very accurately, were essential to secure handsome lozenges. If it be desirable to have the roller warm, such a one, having one of the handles to unscrew and gum-elastic "washer" interposed, will enable the operator to keep the temperature at any heat a little below that of boiling water for some time, and by renewing the heated water to maintain the desired temperature.

Fig. 237 represents a simple apparatus used for rolling and cutting this description of lozenges. Among the recent inventions is a glass roller of considerable strength and durability, designed for rolling out pastry; being open at both ends, it may be filled with warm water and securely corked; in this way a temperature is maintained favorable to the softness and tenacity of the mass. It is well adapted to use in making lozenges. The roller shown in the cut is of hard wood. The rolling-board is adjusted as follows: Having a

Fig. 237



Board, roller, and punch, for making lozenges.

punch of a certain diameter, a small portion of the mass is rolled and cut out, and its weight ascertained; if it be too heavy, the cake is rolled thinner, and so on until adjusted to the required weight; a strip is now tacked on to each side of the board, within the range of the roller, and corresponding in thickness with the cake, so that the roller, when passed over, will reduce the medicated mass to the right thickness. A board arranged in this way should be kept for each kind of lozenges, as the weight of different materials varies, and, in adjusting it, a small allowance must be made for the moisture present in the soft mass, which increases its bulk. In dividing a mass extemporaneously, it is convenient to roll the whole out into a square or oblong cake of suitable size, and then, with a spatula, divide it equally into a definite number of rectangular masses.

Some manufacturers have, independently of their cutting punches, a stamp bearing the name of the base of the lozenge, or the card of the manufacturer, which they impress upon each lozenge; for white lozenges, the punch is sometimes dipped in an infusion of cochineal. The cutting punches are sometimes so made as to combine cutting and marking in one operation.

In order to have lozenges nicely cut, it is important to clean the cutting punch frequently by steeping it for a moment in water, then wiping it dry.

In lozenges made of vegetable powders, as, for instance, those of ipecacuanha, the use of thick mucilage is advised to prevent the extractive matter from coloring the product.

The mucilage used is nearly always made of gum tragacanth, but some pharmacists prefer that of gum Arabic, as giving them a more translucent appearance; white of egg is recommended for the same purpose.

The quantity of mucilage necessary to thicken substances varies somewhat; it is greater for lozenges which contain dry powders than for those made of extractive substances. It may be remarked that lozenges containing a large proportion of mucilage become very hard by time.

Mucilages are sometimes made with simple water, and sometimes with aromatic waters, or the latter are replaced by essential oils added directly to the mass, or in advance to the dry powders.

M. Garot mentions a German method which confectioners sometimes make use of to aromatize lozenges extemporaneously after their desiccation. It consists in dissolving a volatile oil in ether, and pouring this solution upon the lozenges contained in a bottle with a large mouth, shaking them well, then pouring the lozenges upon a sieve, and instantly placing them in a stove to dispel the ether. This method is very convenient, as it permits the preparation of a large quantity of inodorous lozenges, which may be flavored as they are needed.

By means of an atomizer a large number of lozenges may be flavored very quickly and uniformly. The flavoring ingredient is dissolved in ether or strong alcohol and put into the bottle of the

atomizer; the current of air driven rapidly through the instrument is directed for an equal length of time to every part of the mass of lozenges, which should be exposed in thin layers for this purpose.

Second.—Two of the officinal lozenges contain liquorice, and consist of adhesive, saccharine, and mucilaginous materials, softened by water and beaten into a mass with flavoring and medicinal ingredients, and then rolled into lozenges, generally of a different shape from the others.

Trochisci, *U. S. P.*

1st Group.

Officinal name.	Proportion.	Adjuvants.	Med. properties.
Trochisci acidi tannici	1 grain in each	Sugar, tragacanth	Astringent.
" cretæ	4 grains "	Sugar, gum Arabic, and nutmeg	Antacid and astringent.
" magnesiæ	3 " "	Sugar, tragacanth, and nutmeg	Antacid and aperient.
" sodii bicarb.	3 " "	Sugar, tragacanth, and nutmeg	Antacid.
" ferri subcarb.	5 " "	Sugar, tragacanth, and vanilla	Tonic, "hæmatic."
" ipecacuanhæ	¼ grain "	Sugar, tragacanth, orange-flow. water	Expectorant.
" potassii chloratis	5 grains "	Sugar, tragacanth, and vanilla	Disinfectant.
" santonini	½ grain "	Sugar, tragacanth, orange-flow. water	Vermifuge.
" menthæ piperitæ	⅛ minim "	Tragacanth	Carminative.
" zingiberis	Tinct. ℥ij "	Sugar, tragacanth.	"

2d Group.

Trochisci glycyrrhizæ et opii	Ext. opii, 1 gr. in 20 lozenges Liquorice, gum Arabic Sugar, oil anise	Sedative. Expectorant.
" cubebæ	Oleoresin, ½ ℥ in each lozenge Liquorice, gum Arabic Sugar, oil sassafras, and Tolu	Stimulant. Expectorant.
" morphiæ et ipecacuanhæ	Morphia sulph. $\frac{1}{40}$ gr. Ipecacuanha $\frac{1}{12}$ gr. Sugar, tragacanth	Anodyne. Expectorant.

The *preparation* of these is best described by introducing the officinal formulas; their *therapeutical* properties may be noticed as follows: Of the three antacid lozenges, those of *chalk* may be regarded as astringent, adapted to an acid condition of the secretions of the stomach with diarrhœa; those of *magnesia*, as laxative and adapted to remedy costiveness connected with acidity; those of *soda*, as more purely alkaline. The lozenges of *carbonate of iron* have been recommended in the former editions of this work, from which the new officinal formula was taken, as having been long prepared by the author and found to be a most eligible method of giving this nearly tasteless preparation of iron. The dose for children is one, for adults two, three times a day.

The *lozenges of ipecac.* are rarely prescribed, though perhaps well adapted to the treatment of catarrhal affections of children; among the extemporaneous preparations in Part VI., a combination, in this form, containing ipecac. and citrate of potassa is recommended as a diaphoretic. *Peppermint* and *ginger lozenges* are well-known carminatives. Those sold by the confectioners have seldom any special relation to the proportions directed in the *Pharmacopœia.* *Lozenges of tannic acid* are introduced as a pure astringent well suited to certain relaxed conditions of the throat. *Lozenges of santonine* have been introduced in the last edition of the *Pharmacopœia*; their extensive reputation being the result of years of trial. *Lozenges of morphia* and *ipecacuanha* have been made officinal since the last publication, and have been long made under the improved formula for Wistar's.

Wistar's cough lozenges (trochisci glycyrrhizæ et opii), of which an improved formula is given in the sequel, have long afforded a very prominent popular expectorant in Philadelphia and throughout the United States; their peculiar merit consists in their soothing effect in coughs caused by local irritation, and a tickling sensation in the throat; frequently a single lozenge taken at night will allay this symptom and compose the patient to sleep. In some cases of pulmonary consumption they are complained of as producing costiveness, a defect remedied in the improved formula by the substitution of morphia for opium in their composition. It is to be regretted, that, for a small increase of profit, to undersell conscientious pharmacists, some of the largest manufacturers of these lozenges depart from the long-established and well-recognized proportions, producing a very inferior preparation.

Trochisci cubebæ are designed to supersede numerous empirical preparations containing cubebs, which are extensively used for hoarseness and coryza. The new formula is nearly that of *Spitta's lozenges;* its chief fault is that in aiming to combine great efficiency with a form of preparation generally designed to be agreeable, it aims in this case at an impossibility. Most of the popular cubeb lozenges contain much less of the active ingredient, but being less disagreeable, they are taken freely and accomplish the purpose.

Working Formulas for the Officinal Lozenges.

Trochisci Acidi Tannici, U. S. P

Take of Tannic acid, a troyounce.
Sugar, in fine powder, ten troyounces.
Tragacanth, in fine powder, one hundred and twenty grains.
Orange-flower water, a sufficient quantity.

Rub the powders together until they are thoroughly mixed; then with the orange-flower water form a mass to be divided into four hundred and eighty troches.

Trochisci Cretæ. (*Troches of Chalk.*) U. S. P.

Take of Prepared chalk, four troyounces.
Gum Arabic, in fine powder, a troyounce.
Nutmeg, in fine powder, sixty grains.
Sugar, in fine powder, six troyounces.

Rub them together until they are thoroughly mixed; then with water form a mass, to be divided into four hundred and eighty troches.

Trochisci Magnesiæ. (*Troches of Magnesia.*) U. S. P.

Take of Magnesia, four troyounces.
Nutmeg, in fine powder, sixty grains.
Sugar, in fine powder, nine troyounces.
Mucilage of tragacanth, a sufficient quantity.

Rub the magnesia and the powders together until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches.

Trochisci Sodii Bicarbonatis. (*Troches of Bicarbonate of Sodium.*) U. S. P.

Take of Bicarbonate of sodium, four troyounces.
Sugar, in fine powder, twelve troyounces.
Mucilage of tragacanth, a sufficient quantity.

Rub the bicarbonate of sodium with the sugar until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty grains.

Trochisci Ferri Subcarbonatis, U. S. P. (*Iron Lozenges*).

Take of Subcarbonate of iron, five troyounces.
Vanilla, sixty grains.
Sugar, in fine powder, fifteen troyounces.
Mucilage of tragacanth, a sufficient quantity.

Rub the vanilla first with a part of the sugar into a uniform powder, and afterwards with the subcarbonate of iron and the remainder of the sugar until they are thoroughly mixed. Then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches.

Ferruginous Chocolate Drops. (Unofficinal.)

Take of Reduced iron (by hydrogen) . . . . . 1 part.
Vanilla chocolate . . . . . 15 parts.

With the fused chocolate incorporate the iron uniformly, and form into moulds each containing eight grains. Dose, one for a child, two for an adult, three times a day.

Trochisci Ipecacuanhæ. (*Troches of Ipecacuanha.*) U. S. P.

Take of Ipecacuanha, in fine powder, one hundred and twenty grains.
Tragacanth, in fine powder, one hundred and twenty grains.
Arrowroot, in fine powder, two troyounces.
Sugar, in fine powder, eight troyounces.
Syrup of orange-peel, a sufficient quantity.

Rub the powders together until they are thoroughly mixed; then with syrup of orange-peel form a mass, to be divided into four hundred and eighty troches.

Trochisci Menthæ Piperitæ. (*Troches of Peppermint.*) U. S. P.

Take of Oil of peppermint, a fluidrachm.
Sugar, in fine powder, twelve troyounces.
Mucilage of tragacanth, a sufficient quantity.

Rub the oil of peppermint with the sugar until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches.

Trochisci Zingiberis. (*Troches of Ginger.*) U. S. P.

Take of Tincture of ginger, a fluidounce.
Tragacanth, in fine powder, half a troyounce.
Sugar, in fine powder, twenty troyounces.
Syrup of ginger, a sufficient quantity.

Mix the tincture of ginger with the sugar, and, having exposed the mixture to the air until dry, reduce it to fine powder; to this add the tragacanth, and mix it thoroughly. Lastly, with syrup of ginger form a mass, to be divided into four hundred and eighty troches.

Trochisci Cubebæ. (*Troches of Cubeb.*) U. S. P.

Take of Oleoresin of cubeb, half a fluidounce.
Oil of sassafras, a fluidrachm.
Liquorice, in fine powder, four troyounces.
Gum Arabic, in fine powder, two troyounces.
Sugar, in fine powder, three troyounces.
Syrup of Tolu, a sufficient quantity.

Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil, and incorporate them with the mixture. Lastly, with syrup of Tolu form a mass, to be divided into four hundred and eighty troches.

These are conveniently made into the shape of *Spitta's lozenges*, for which a formula was given in a previous edition. The mass being divided into portions of half a troyounce, each of these is rolled out between two boards to a cylindrical stick, and then after it has partially dried it is cut with a sharp knife into twenty-four equal parts, each weighing about ten grains.

Trochisci Glycyrrhizæ et Opii. (*Troches of Liquorice and Opium.*) U. S. P.

Take of Extract of opium, in fine powder, twenty-four grains.
Liquorice, in fine powder, two troyounces.
Gum Arabic, in fine powder, one troyounce.
Sugar, in fine powder, three troyounces.
Oil of anise, fifteen minims.

Rub the powders together until they are thoroughly mixed; then add the oil of anise, and incorporate it with the mixture. Lastly,

with water form a mass, to be divided into troches, each weighing six grains.

The formation of a mass with these ingredients possessing the requisite softness and pliability, and yet firm enough to retain the shape given to it, is a matter of considerable difficulty, even with those who are somewhat accustomed to it, while those who are not often waste their material, as well as their time, in the manipulation.

The following modified formula will be found an improvement:—

Take of Powdered liquorice,
Powdered gum Arabic,
Powdered sugar, each . . . . . 5 ounces.
Oil of aniseed . . . . . 30 drops.
Sulphate of morphia . . . . . 12 grains.
Water, and
Tincture of Tolu, of each . . . . . A suffi. quantity.

Dissolve the sulphate of morphia in one fluidounce of water, and add the oil of aniseed, with sufficient powdered gum Arabic to incorporate it thoroughly. To this add one fluidounce of water, or a sufficient quantity; add this, now, to the mixed powders, and beat thoroughly into a mass of the proper consistence. This is to be divided into lozenges, each weighing six grains, and these, after they are dry, are to be varnished with tincture of Tolu.

The mode of rolling and dividing these (and, consequently, their shape) is different from that indicated for the lozenges of the first group. After beating the ingredients into a mass, portions of 168 grains each are weighed out, and each of these, being rolled between two smooth pieces of board, into a cylindrical stick 28 inches in length, is laid away upon a drying board until nearly dry and brittle, and then cut with a sharp knife or scissors into 24 equal lozenges, each about $1\frac{1}{8}$ inch in length, and weighing 7 grains when moist, but reduced in weight by drying.

About twelve lozenges contain an ordinary adult dose of sulphate of morphia. Made by this recipe, they are less liable to constipate the bowels, and are less bitter to the taste than the officinal.

Trochisci Morphiæ et Ipecacuanhæ. (*Troches of Morphia and Ipecacuanha.*)

Take of Sulphate of morphia, twelve grains.
Ipecacuanha, in fine powder, forty grains.
Sugar, in fine powder, ten troyounces.
Oil of gaultheria, five minims.
Mucilage of tragacanth, a sufficient quantity.

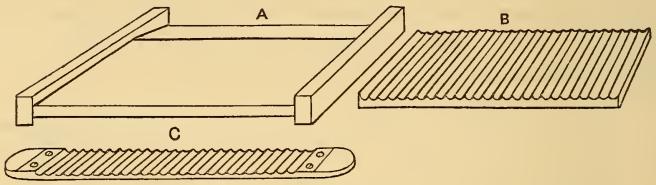
Rub the powders together until they are thoroughly mixed; then add the oil of gaultheria, and incorporate it with the mixture. Lastly, with mucilage of tragacanth form a mass, to be divided into four hundred and eighty troches.

Fig. 238 exhibits the apparatus used for making lozenges of the form that Wistar's and Spitta's, two popular lozenges in Philadelphia and many other parts of this country, are ordinarily made.

A represents a board about 27 inches long, 20 wide, and an inch thick; at five inches from one side, the surface is planed off to a

thickness of one-fourth of an inch, slanting uniformly. On the under side at each end is a strip $\frac{3}{4}$ of an inch thick, extending the whole width of the board; and at each end on the top are brass pieces $\frac{1}{5}$ of an inch in thickness, secured by screws. B represents the roller

Fig. 238.



board, which is about 33 inches long, four or five inches wide, and $\frac{3}{4}$ of an inch thick, with guides which fit the guides on the board upon which the mass is rolled; in the back of this board parallel pieces of brass are set $\frac{3}{4}$ of an inch apart. C represents a board having parallel semi-cylindrical grooves extending from end to end, in which the lozenges are received and kept till dry enough to pack.

Unofficinal Lozenges.

Dr. Jackson's Pectoral Lozenges.

Take of	Powdered ipecacuanha	10 grains.
	Sulphuretted antimony	5 grains.
	Muriate of morphia	6 grains.
	Powdered gum Arabic,	
	Powdered sugar,	
	Powdered ext. of liquorice, of each	11 drachms.
	Tincture of Tolu	4 drachms.
	Oil of sassafras	4 drops.

To be made into a stiff mass with simple syrup, and divided into 200 lozenges, or into lozenges of 10 grains each. Each lozenge contains $\frac{1}{20}$ grain of ipecac., $\frac{1}{40}$ grain of the antimonial, $\frac{1}{33}$ grain of morphia. They are usually rolled into flat cakes, and cut out with a round punch, as described under the head of the officinal lozenges.

Few remedies for pectoral affections requiring anodyne and nauseant treatment are so popular as this. Dose, one every three or four hours.

Dr. Jackson's Ammonia Lozenges.

Take of	Muriate of ammonia	1½ drachms.
	Muriate of morphia	3 grains.
	Powdered elm bark	6 drachms.
	Powdered gum Arabic,	
	Powdered sugar,	
	Powdered ext. of liquorice, of each	7 drachms.
	Tincture of Tolu	3 drachms.
	Oil of partridge-berry	4 drops.

To be made with syrup into 180 lozenges, or into lozenges of 10 grains each, containing $\frac{1}{2}$ grain muriate of ammonia, and $\frac{1}{60}$ of a grain of the morphia salt.

These are used for somewhat similar affections with the foregoing, and are made into the same shape.

Parrish's Cough Lozenges.

Take of	Powdered ipecacuanha	50 grains.
	Kermes mineral	100 grains.
	Sulphate of morphia	16 grains.
	Powdered sugar,	
	Powdered gum Arabic,	
	Powdered ext. of liquorice, of each	3 ounces.
	Oil of anise	40 drops.
	Syrup of Tolu	Sufficient.

To be made into a mass and divided into 320 lozenges, each containing about $\frac{1}{6}$ grain of ipecacuanha, $\frac{1}{3}$ grain of kermes, $\frac{1}{20}$ grain of morphia salt.

We have been in the habit, for the last ten years, of preparing these pectoral lozenges, which are not unlike those of Dr. Jackson. The recipe was made with the advice of a medical friend, and has proved a useful one, producing a comparatively active preparation.

The dose of these is one three or four times a day.

Phosphatic Lozenges.

Take of	Phosphate of calcium	10 ounces.
	Phosphate of iron	2 ounces.
	Phosphate of sodium	6 drachms.
	Phosphate of potassium	2 drachms.
	Phosphoric acid	2 drachms.
	Sugar, in powder	17 ounces.
	Powdered ginger,	
	Syrup, of each	Sufficient.

Mix the phosphates of calcium and iron with the sugar and ginger, by passing through a fine sieve; then, by the aid of heat, dissolve the phosphates of sodium and potassium and phosphoric acid in the syrup, and make into a mass with the mixed powders. Roll this into a cake of the proper thickness, dusting it with a sifted mixture of one part of phosphate of iron and eight parts of sugar, and cut out the lozenges, each weighing fifteen grains.

Each lozenge contains five grains of phosphate of calcium, one grain of phosphate of iron, and half a grain of the mixed phosphates of sodium and potassium.

The use of the phosphates prescribed above has recently been adopted, to a large extent, with a view to supplying elements to the system which are apt to be deficient, particularly among children, in large cities. It is asserted that these salts not only aid in building up the bony structure, when it is deficient, but assist in maintaining the irritability, without which assimilation and nutrition are always lacking. The dose for children may be from one to two, three times a day.

Astringent Rose Leaf Tablets.

Take of Powdered catechu,	
Powdered red rose, of each	6 parts.
Powdered tragacanth	1 part.
Powdered sugar	48 parts.

Mix, and make into a mass with rose-water and vanilla syrup, then divide into lozenges of ten grains each. To be taken *ad libitum* for chronic relaxed conditions of the throat and mouth.

Chlorate of Potassium Tablets.

Take of Chlorate of potassium	200 grains.
Powdered red rose	300 grains.
Powdered sugar	500 grains.
Oil of rose	15 drops.
Oil of orange	100 drops.

Reduce the chlorate of potassium to a very fine powder, separately, for fear of explosion, and incorporate it thoroughly with the other dry ingredients by sifting together; add to these the flavoring oils and make up the mass with jelly of black currants, then divide into 100 lozenges, each containing ten grains. DOSE, one occasionally in sore throat, ulcerated mouth, etc.

Catechu Lozenges.

Take of Catechu	2 ounces.
Tragacanth	½ ounce.
White sugar	12 ounces.
Rose water	Sufficient.

Make into ten-grain lozenges; to be used *ad libitum*.

These are particularly adapted to cases of relaxation of the uvula, irritation of the larynx, etc.

Wild Cherry Tablets.

Take of Wild cherry bark, finely powdered	℔j. (officinal).
Alcohol	q. s.

Make a tincture by percolation, evaporate to dryness, and power the extract—to this add

Powder of blanched almonds	℥iij.
Gum	℥iv.
Sugar	℔iij-℥iv.

The above modification of the formula of W. R. Warner produces a fine preparation, retaining the sedative virtues of the drug as concentrated as is safe in this form of preparation.

Make a mass, and divide into oval lozenges of ten grains each. They are very bitter, and develop hydrocyanic acid when introduced into the mouth, acting with energy as a sedative remedy. One lozenge is a dose, repeated as occasion requires.

The pharmacist will often find, especially in very damp, warm weather, difficulty in drying lozenges, particularly those which contain deliquescent and very soluble salts, such as muriate of ammo-

nia. This difficulty has been overcome by the use of a box, made of well-seasoned wood free from cracks or loose knots, lined with paper pasted carefully over the inside, the lid being hinged on, and the edge of the box where the lid rests being covered with thick, soft, white skin. Shelves are arranged on which to support the lozenges or other substances while drying, and a tray in the bottom is provided for holding a quantity of unslaked freshly burnt lime; after the lime and articles to be desiccated are arranged in the case, the lid is securely closed and kept shut for such a space of time as is requisite to insure the absorption of the moisture from the article by the lime.

Candy and Drops.

Various kinds of candy are used in medicine for the well-known expectorant or demulcent properties of the sugar alone, or for the effects of such medicines as may be conveniently combined with it. The manufacture of these pertain almost exclusively to the confectioner, who prepares a thick semifluid mass by using with the sugar a small portion of water, and boiling till it is brought to such condition that a small portion removed from the fire upon a glass rod will solidify into a transparent candy on cooling; it is then poured out upon a marble slab. If the coloring or flavoring ingredient is in powder, as, for instance, tartaric acid used in making lemon drops, it is worked in with the melted candy on the slab; otherwise it must be added before testing its hardness and removing from the fire. The sheet of melted candy, being smoothed upon the surface, if designed for secrets, a very common form, is partially cut through into squares, and then, when brittle, broken off; if designed for drops, the candy requires to be run into moulds upon a machine constructed for the purpose; if for sticks, it is rolled and drawn out to the required thickness.

By kneading and working this material while soft, its whiteness is increased. The principal art in making candies is in the removing them from the fire at just the right moment before *caramel* begins to be formed, and not until the whole of the uncombined water is driven off; besides the proximate mode, with a glass rod, given above, the elevation of the boiling point to exactly a certain point is an indication that the candy is finished.

The fruit essences, so called, prepared by artificial processes from *fusel oil*, have been much used of late to flavor drops. Lemon and ginger drops are also much in vogue; the latter are best prepared from the piperoid or oleoresin of ginger (see p. 693).

The following recipes are appended, as of utility to the pharmacist, who may procure the admixture of the medicinal ingredients, with candy at the confectioner's for a few cents per pound advance on the cost of the sugar.

Ginger Drops.

To ten pounds of the melted candy add one ounce of piperoid of ginger, and, by means of an appropriate apparatus, run it into drops the size of cherry-stones.

Medicated Secrets, or Cough Candy.

To ten pounds of melted candy add the following mixture, and divide into secrets:—

Take of Tincture of squill	f℥iv.
Camphorated tincture of opium,	
Tincture of Tolu, of each	f℥ss.
Fluid extract of ipecacuanha,	
Oil of gaultheria, of each	♏viij.
Oil of sassafras	♏vj.
Oil of aniseed	♏iij.

Used *ad libitum* in ordinary coughs.

CHAPTER XIV.

EXTRACTA RESINA AND "CONCENTRATED REMEDIES."

The number of *Eclectic Concentrated Remedies* in common use, and the general interest felt in them, which has now extended to transatlantic countries, seem to demand that an effort should be made to include in this work some notice of all of them, which are liable to be met with by physicians and pharmacists. The manufacturers of these preparations are all independent of each other; each claiming the superiority of his own preparations over those of his rivals; each adopting such formulas, and such nomenclature, as his own convenience suggests. For many of them no formulas are published, and no accurate description of their chemical and physical properties has appeared, while an examination for the purposes of this work would be unnecessary.

Some of the "Eclectic remedies" are nearly pure resins, like three *Resinæ* of the *British Pharmacopœia*. Viewed as pharmaceutical preparations, eligible for use in medicine, though not purified so as to rank as distinctive proximate principles, these are very appropriately named resinous extracts or resins. The term "Resinoid," so commonly used, is less appropriate to the class, implying, as it does, a resemblance to resins, while all of these are either resins, oleoresins, or more or less mixed proximate principles possessing no real resemblance to the class of resins. Some of the concentrated remedies lay claim to the title of "Alkaloids;" these either are or are not vegetable alkalies, though never pure; and the same objection applies to designating them under a name which is

far from being clearly descriptive of their chemical character. It is a scientific objection to the nomenclature of the eclectics that they use the terms employed by chemists to designate the distinctive principles isolated from the plants by analysis, and it is a practical objection to their system that medicines of such totally different chemical properties are grouped together under similar designations. The termination *in*, so appropriate to resins and neutral principles, is not adapted to extractive matters containing no resin; and the termination *ia*, though quite appropriate to organic alkalies, is unsuited to the mixed principles precipitated by the empirical processes of these manufacturers. Two preparations differently prepared from the same drug, such as "sanguinarin and sanguinarina," possessing different degrees of therapeutic power—the one classed by them as a resinoid, and the other as an alkaloid—should be more definitely designated than by names differing only in the terminal letter.

A frequent cause of error in the practice of pharmacy arises out of the substitution of the "Eclectic hyoscyamin, atropin, veratrin, and similar preparations," for the pure vegetable alkalies found in commerce. The dose is, of course, very different; and, the genuine articles imported from England, France, and Germany bearing a very high price, the substitution of cheaper and inferior products labelled with the same names should be carefully guarded against.

In the present chapter the principal resinous and other "Eclectic concentrated remedies" are noticed without regard to their strictly chemical characters, while the definite proximate principles of plants used in medicine, which have been isolated and examined, are noticed under their several heads in Part IV. Many of the formulas and descriptions given in this chapter are not practically familiar to the author, and are given as recorded in the several works on this system of practice. Of these, the chief that have been consulted are the following: "*The American Dispensatory*, by John King, M.D.," published in Cincinnati in 1859, and recommending the "resinoid and alkaloid" preparations of W. S. Merrill and others of that city. "*Concentrated Organic Medicines, being a Practical Exposition of the Therapeutic Properties and Clinical Employment of the Combined Proximate Medicinal Constituents of Indigenous and Foreign Plants*, by Grover Coe, M.D.," fourth edition, 1862, published by B. Keith & Co., New York, of whose preparations it treats. And "*Formulas for making Tinctures, Infusions, Syrups, Wines, Mixtures, Pills, etc.*, from the fluid and solid extracts prepared at the laboratory of Tilden & Co., New Lebanon, N. Y."

The statements of these authors are not to be accepted as impartial. Each of the two first named is much engaged throughout in disparaging the preparations recommended by the other. The Cincinnati work, in which many formulas appear, justly charges the New York manufacturers with concealing their formulas, and advances the following criticism: "Unfortunately some persons are so wrapped up in what are called 'concentrated remedies' that they

will blindly employ anything presented as such without stopping to inquire or examine into its claims; this is decidedly wrong."

On the other hand, Dr. Grover Coe, writing in the interest of the New York manufacturers of concentrated remedies, repudiates the single principles or precipitates obtained by the same process for almost every variety of vegetable substance as recommended by Merrill and indorsed by Dr. King. He claims for his remedies that they embody not merely single "resinoid," or "alkaloid," or "neutral" principles from plants, but all these as contained in their several plants first separately isolated and then recombined, which is practically impossible and scientifically absurd.

This extraordinary assertion, taken in connection with the great number and variety of remedies advertised claiming to be the "concentrated equivalents" of plants but little known to chemists, and never satisfactorily analyzed, cannot but strike the mind of any one in the least acquainted with the difficulties of the subject as too severe a tax on credulity.

The classification of the proximate principles of plants adopted by Dr. Coe is, moreover, different from any known to science, and some of the definitions given to the several classes named do not correspond with those of the recognized authorities. Thus the oleoresins are stated to be compounds of fixed oils, wax, and resin, while balsams are defined as mixtures of resin and volatile oil. A distinction is drawn without a difference between resins and resinoids. Neutral principles, which the author claims to have been "the first to recognize in their true remedial value, and the first to establish in their identity as a class of distinct proximate principles, and the first to record their physical and chemical characteristics," are said to be altered in their composition or completely destroyed in the preparation of extracts, etc. In the definition of these they are quite confounded with the nondescript and almost infinitely varied "extractive" substances which have no single character in common, and are fast disappearing from the catalogue of vegetable products before the searching scrutiny of modern chemistry.

It is but simple justice to those who are asked to accept remedies prepared by secret processes upon faith in the manufacturer, that his claims, and those of his sponsors, should be somewhat inquired into.

It would be in vain to deny that improvement in the extraction and concentration of medicines is a growing demand of our times, but the efforts of the so-called "eclectic pharmaceutist" in that direction have been marred by a too exclusive reliance upon the single process of precipitation from a strong alcoholic tincture by water—a process well adapted to those cases in which the active principle of the drug is distinctly resinous, but unsuited to a large number of vegetable substances, the active principles of which are more or less completely soluble in water.

The practice of bringing all these concentrated remedies to the condition of powders by the addition of sugar of milk, or other

dry material, to those which are naturally soft or oily, has many objections, among which are their unnecessary dilution, and the increased exposure of their particles to oxidation or evaporation.

An important objection to this system of practice is that while it claims to be eclectic, it is, in fact, exclusive, confining its remedies almost entirely to indigenous drugs of vegetable origin. It must be confessed that the variety of our indigenous materia medica is very great, and perhaps sufficient for most purposes of the physician; but there is neither philosophy nor policy in creating an exclusively American system of practice, while by commerce, by literature, and science, our country is linked with all the civilized world.

The remaining objection to this system is the want of candor and scientific truthfulness which pervades its literature. There is an obvious special pleading in arguments, and an aim to promote local business interests in its publications, which necessarily detract from its reputation and shut out its professors from the sympathy and countenance of the class whose influence can least be spared from any scientific reform.

The so-called "American system of practice" requires a protest against its exclusiveness, its empiricism, and its unprofessional character; but that whatever of good it contains may be made known, the present chapter is devoted to a notice of the remedies offered by its rival schools.

The "Eclectic remedies" are preceded in the present chapter by the new officinal class *Resinæ*, one of which, resina podophylli, originated with practitioners of that school, and is the most popular representative of its class.

Resinæ, U. S. P.

Officinal name.	Dose.	Properties.	Synonyme.
Resinæ jalapæ	grain v	Cathartic	Jalapin.
" podophylli	grain ij	"	Podophyllin.
" scammonii	grain v	"	Resin of scammony.

REMARKS.

The resins of jalap and May-apple roots, as above, are prepared by percolation with alcohol through the finely powdered root until the percolate ceases to cause a precipitate on being dropped into water, in the case of the former preparation, but in the case of podophyllin acidulated water is directed to be used. This is then to be reduced to about half the quantity of the root employed (the alcohol being recovered by distillation), and thrown into eight times its bulk of water, which precipitates the resin; this is then washed and dried and powdered, in which state it is dispensed.

For the characteristic distinctions of resin of jalap and podophyllin, the reader is referred to *Am. Journ. Pharm.*, 1862, p. 113.

Resin of podophyllum is of a color varying from a drab to a bright

yellow. As above prepared, it is less tinged with yellow than in the usual process of the manufacturers, in which muriatic acid is added to the water with which it is to be precipitated. It is partly soluble in ether, and the residue, when dissolved in solution of potassa, is precipitable by dilute muriatic acid in excess. Prof. F. Fullager has lately announced the existence in the root of podophyllum of the alkaloid *berberina*, which was previously noticed by Mr. Hodgson, Jr., as yellow coloring matter; being soluble in cold water this is lost by the officinal method of preparation; but owing to the insolubility of the yellow muriate of berberina it is mixed with the precipitated resin, and accounts for the yellow color of the commercial *podophyllin*, and in part for some of its properties.

Resin of scammony is directed to be prepared according to the *U. S. P.* from commercial scammony by digesting with successive portions of boiling alcohol until exhausted, mixing the tinctures, evaporating to a syrupy consistence by distilling off the alcohol, adding the concentrated liquid to water, washing and drying the precipitate. It is wholly soluble in ether, also in officinal solution of potassa, from which solution an excess of diluted muriatic acid does not precipitate it.

A resin of scammony is prepared from the dried roots by the process of the British *Pharmacopœia*, which differs from the foregoing. The roots are digested with water and with diluted acid, by which means they are deprived of all matter soluble in these menstrua, then with alcohol, which dissolves out the resin, which is collected on the recovery of the alcohol by distillation. The roots are collected in Asia Minor, dried and shipped to London, where this resin is now manufactured. The physical qualities of the scammony thus prepared differ considerably from virgin scammony and from the officinal resin, being non-porous, not producing a lather when rubbed with water, and, instead of possessing a musty or sour cheese-like odor, having an aromatic and fruity smell. Its dose is from four to twelve grains.

Medical Properties.—The medical properties of these three resins are somewhat similar. *Resin of jalap* has long been known as a powerful cathartic, in doses of from one to five grains, triturated with sugar or other diluents or correctives.

Podophyllin is undoubtedly one of the most powerful purgatives in use, acting, in doses of two to four grains, as a drastic cathartic, accompanied in its action with much nausea and griping. In smaller doses ($\frac{1}{4}$ grain to one grain), it operates as an alterative and cholagogue. It is claimed for this remedy that it is a regulator of the secretions, tending to restore them to normal activity, and that it completely supersedes mercury in all cases where it is indicated, even, in some cases, producing ptyalism. It is seldom or never employed alone, its effects being greatly increased, and its dose lessened, according to the testimony of practitioners accustomed to its use, by long trituration with four to ten times its weight of sugar or sugar of milk. "Caulophyllin" combined with it is said to materially lessen its painful and disagreeable effects. A com-

pound of podophyllin, with ten parts of "leptandrin" and ten of sugar, is esteemed as an alterative in dyspepsia; the discovery of the presence of berberina in the commercial podophyllin explains its known tonic effects.

Resin of scammony has been very rarely prescribed; it was officinal for the first time in 1860, as distinct from the impurities associated with it as commercial scammony. It was made officinal for the purpose of introducing it as an ingredient into the compound extract of colocynth. Its high cost deters all but the most conscientious manufacturers from complying with the officinal directions in this respect.

Unofficinal Concentrated Remedies.

Apocynin is the name given to a preparation by J. B. Robinson, formerly of Cincinnati, from the root of Apocynum androsæmifolium, and recommended by Dr. John King in his *Dispensatory*. The formula directs the preparation of a saturated tincture of the root, treating this with ammonia, then filtering and precipitating the apocynin with sulphuric acid, added gradually; it is to be washed in one or two waters and then dried. One pound of the root yields about half an ounce. It is represented as a powder of a dark brown color, a strong odor of the root, and a bitter, nauseous, and unpleasant taste. It is recommended in jaundice, hepatic torpor, and constipation, combined in equal parts with leptandrin and myricin. This dose, as given by Tilden, is ½ to 2 gr. Another remedy called *apocynine* is mentioned by "eclectic" writers, described as being very bitter and of a dark orange color.

Alnuine and *Alnuin* are names given to preparations derived from the bark of Alnus rubra (Tag Alder). The last named is recommended as possessing alterative, tonic, and sub-astringent properties in doses of one to three grains three or four times a day. The other is said to be adapted to the same purposes. Alnuin is announced in Tilden's *Formulary* as useful in herpes, syphilis, scorbutus, impetigo, etc., and by Dr. Grover Coe as adapted to scrofula, eruptions of the skin, rheumatism, and syphilis, and wherever an alterative is required.

Ampelopsin is a preparation from Ampelopsis quinquefolia (Virginia creeper), made by an unpublished process; it is reputed to be alterative, diuretic, expectorant, anti-syphilitic, astringent, and tonic. Dose, 3 to 10 grains.

Asclepidin is a concentrated preparation from Asclepias tuberosa (pleurisy root), obtained by a process similar to that for the resin cimicifugin, and is a dark semi-liquid extractive-like mass. Its dose is from 1 to 5 grs. three times a day, as an expectorant, diaphoretic, and tonic. It is recommended in fevers of every type, inflammatory diseases, hooping-cough, and in chronic diseases of digestive organs, and Dr. Coe speaks of Keith's asclepin as *universally admissible in the treatment of disease.*

Ascletine is described as a white powder, with but little taste or

odor, recommended as the active principle of the plant; but the editor of the *Eclectic Dispensatory* thinks it "an imposition upon the profession."

Barosmin, derived from buchu by an unpublished process, is asserted by Dr. Grover Coe to be a diuretic, alterative, diaphoretic, tonic, stimulant, antispasmodic—properties which have not been claimed for the leaves themselves. DOSE, from 2 to 4 grains.

Baptisin is a preparation prescribed by the "eclectic" practitioners from the bark of the root and the leaves (?) of Baptisia tinctoria wild indigo), one of our familiar indigenous weeds. In its chemical nature it seems to be a resinous extractive, which is said to be precipitated by an acid, or by acetate of lead, from the saturated tincture. The formula has not been published. It is described as of a yellowish-brown color, a strong and characteristic odor, and a bitter, disagreeable, persistent taste. It is only partially soluble in alcohol, much more so on the addition of ammonia or potassa. It is given in a dose of from $\frac{1}{4}$ to $\frac{1}{2}$ grain with a view to increase the action of the glandular system and to arouse the liver, also as an external application to gangrenous and erysipelatous ulcerations. Variously combined it is much prescribed in "eclectic" practice. In large doses it is said to produce very disagreeable prostration.

Caulophyllin.—This preparation, from the root of Leontice thalictroides (Michx.), Caulophyllum thalictroides (blue cohosh), is made by Merrill, by precipitation from the saturated tincture, similar to the preparation of podophyllin and cimicifugin, using, however, as small a quantity of water as possible to prevent waste, as the precipitate is soluble. Caulophyllin thus prepared is an extractive substance of a light brown color, with a peculiar, not unpleasant odor, and a slightly bitter taste, and some degree of pungency. It is said to be insoluble in ether, partially soluble in water, more so in alcohol; the addition of solution of ammonia renders it soluble in either menstruum, and the solution becomes a dark wine color.

The following process for obtaining caulophyllin is by Dr. F. D. Hill, of Cincinnati: Exhaust the root of caulophyllum with alcohol and obtain a thick fluid extract, add this to twice its volume of saturated aqueous solution of alum, and place it aside to rest for three or four days; then place it on a filter cloth, and allow the water to filter through; wash the product two or three times with fresh water, and let the residuum dry in the open air. When dry, it readily forms a powder of a light grayish color.

The ordinary dose of caulophyllin is from one-fourth of a grain to one grain, three or four times a day, its therapeutic effect being exerted on the uterus, as a tonic and alterative. As a parturient it is given in doses of from two to four grains, at intervals of 15 to 30 minutes after actual labor has commenced.

Caulophyllin is said to be prepared by some manufacturers from an aqueous infusion of the root, decolorized by animal charcoal, and concentrated in *vacuo* by adding infusion of galls, or 96 per cent. alcohol, collecting the precipitate, drying and powdering it. It is then sold as an "*alkaloid*," although its properties are said not to

vary much from those of the first, which is usually considered as a "*resinoid.*"

Ceanothine is the name given to a preparation described in the *New York Journal of Organic and Medical Chemistry*, vol. i. page 43, as prepared from the leaves of the New Jersey tea, Ceanothus Americanus, by the following process: First extract the coloring and resinous matter from the leaves by alcohol, then place the mass in an alembic apparatus (?) and displace the alcohol remaining in it, after which the mass is to be subjected to the percolating process with hot distilled water until the active principle is displaced. The aqueous solution is then evaporated in *vacuo* to the consistency of thick syrup, and precipitated and purified in nearly absolute alcohol. The precipitate is then directed to be dried into a partially crystalline mass, in a vacuum at about 100° F. The preparation reduced to powder is said to be nearly white, and to resemble green tea in odor and taste. It is soluble in water, but nearly insoluble in alcohol, in which properties it appears to resemble some of the so-called eclectic "alkaloids," as caulophyllin.

This process, like many others, is too obscure to be used by the uninitiated, and the preparation can only be adopted by those who accept it on the ground of confidence in the manufacturers.

Cerasein is the only preparation derived from the unofficinal bark of Cerasus Virginiana (choke cherry). It is highly lauded by Dr. Grover Coe as a substitute for quinine in certain conditions of the system wherein the vegetable alkali is inadmissible. He represents that *cerasein* contains "resinoid" and neutral principles besides amygdalin, phloridzin, and picrin. Dose, 5 to 10 grains. It is not made by the eclectic manufacturers generally.

Chelonin is a "resinoid," prepared from Chelone glabra (balmony). No formula is published for it, but it appears to be given in doses of from 1 to 2 grains, as a representative of the leaves from which it is prepared. These are accounted tonic, cathartic, and anthelmintic.

Cimicifugin, or Macrotin, another eclectic "resinoid," is prepared by forming a concentrated tincture of black snakeroot, *Cimicifuga racemosa*, diluting it with its bulk of water, and distilling off the alcohol. It is then collected from the bottom of the vessel and powdered. A modification of this process by Prof. E. S. Wayne, yields a more elegant and more active preparation. He directs that the strong tincture shall be allowed to evaporate spontaneously, until a solid mass is deposited, the remaining fluid is poured off and the mass dissolved in alcohol, slowly evaporated to the consistence of a fluid extract, and then placed in thin layers upon glass and allowed to dry.

As usually found in commerce, this is a dark-brown powder, of a faint odor, and a slightly bitter nauseous taste. It has not been analyzed, but appears to be an impure resin. I obtained 4¾ per cent. of it in my experiments. (See paper on Eclectic Pharmacy, *Am. Journ. Pharm.*, vol. xxiii. p. 329.) Its medical properties are described in Dr. King's *Dispensatory* as tonic, alterative, nervine,

anti-periodic, with an especial affinity for the uterus. It does not, according to this authority, possess the narcotic properties of the root. Dr. Grover Coe considers the macrotin of Keith as alterative, antispasmodic, stimulant, diaphoretic, diuretic, expectorant, resolvent, nervine, emmenagogue, parturient, tonic, and narcotic, and enumerates twenty-eight diseases in which it is employed. In regard to this particular manufacture, it may be remarked that it claims to be composed of three principles, "resinoid, alkaloid, and neutral." Cimicifugin is considerably used by practitioners in the treatment of chorea. Of course, a great variety of combinations may be resorted to as occasion requires, and it undoubtedly deserves a fair trial of its merits, especially as it is a preparation free from the suspicion of empiricism or secrecy. Its dose is from 1 to 6 grains.

Chimaphilin, catalogued among the concentrated medicines of one of the eclectic manufacturers as an alterative, tonic, diuretic, and astringent, is derived from Chimaphila umbellata by the following process: Agitate a tincture of pipsissewa with chloroform, allow the mixture to stand, remove the lighter liquid, and permit the chloroformic solution to evaporate. The crystalline residue should be purified by solution in alcohol, filtration, and spontaneous evaporation. The dose is 2 or 3 grains.

Collinsonin, derived from Collinsonia canadensis (hard-hack, or stone root), is represented by Dr. Coe as a valuable tonic, astringent, diaphoretic, alterative, resolvent, and diuretic, in doses of 5 grains.

Cornine is the name applied to a precipitate, obtained by adding to water a saturated tincture of the bark of Cornus Florida (dogwood). The details of this method are probably varied by the several manufacturers, and the results, doubtless, differ accordingly. It is usually a light grayish-brown powder, of a peculiar odor, slightly bitter, astringent taste; insoluble in water, diluted acids, and volatile oils; nearly soluble in alcohol, entirely with the assistance of ammonia or caustic potassa, which also renders it partially soluble in water. It is soluble in ether, and ammonia added removes the cornine in solution, leaving the ether transparent on the surface. (King's *Dispensatory*.) The peculiar bitter principle seems to have been obtained by Prof. J. M. Maisch in solution, but its extreme facility of decomposition prevented its isolation.

How far this product is a representative of the active principles of the bark has not been fully shown, nor do I know whether it resembles the preparation long vended under the same name by the late G. W. Carpenter, of Philadelphia.

Dr. Coe's work represents the *cornin* of B. Keith & Co. as containing the proximate principles soluble in alcohol and those soluble in water—tannic acid, etc.—in the proportion in which they exist in the bark, and hence that it is a more perfect representative of the bark than the "resinoid" cornine of Merrill and other manufacturers. A specimen I have examined was equally soluble in water and alcohol, and was evidently composed in great part of tannic acid.

Dog-wood bark has, for many years, had an excellent reputation as a tonic and astringent, and has been used with success in the treatment of intermittents, and it is claimed that cornine in 10-grain doses is an excellent anti-periodic, adapted to supersede quinia where, from any cause, it is contraindicated, or where it is not readily procurable. Of course, this statement must be taken with allowance. As a general tonic, it is prescribed in doses varying from one to ten grains.

Corydalia.—The small round tubers of Corydalis formosa are largely collected in the Western States of the Union, and considerably used under the name of Turkey corn, as a domestic and eclectic alterative remedy. Analysis has discovered the presence of a vegetable alkali named *corydalina*, which is described in the chapter on vegetable alkalies. The eclectic preparations, as issued by different manufacturers, are called corydalia and *corydalin;* the former claiming to be an "alkaloid," and the latter a "resinoid" principle. Merrill's process for corydalia consists in adding water to the tincture, collecting the precipitate, then adding ammonia and collecting the additional precipitate, filtering and adding muriatic acid, when "the balance of the alkaloid" is precipitated. That the mixed precipitates, which, according to Merrill, amount to little more than an ounce from four pounds of the tubers, can lay claim to be the alkaline active principle of the drug, will be disputed by many; it is, however, highly spoken of as an alterative by Dr. King, who says "it will be found useful in all scrofulous and syphilitic affections, as well as in many cutaneous diseases." *Corydalin*, issued as a "resinoid," of which there is no published formula, is recommended for the same purposes, in the same dose—from ½ grain to 1 grain. (King.) Keith's preparation containing resin, resinoid, alkaloid, and neutral principle, is given, according to Coe, in 2-grain doses. Combinations of these preparations with berberin, hydrastin, ptelein, etc., are recommended as tonic, and with podophyllin, xanthoxylin, stillingin, iridin, phytollaccin, etc., as alterative. The custom of giving these combinations to the exclusion of individual remedies is not favorable to a clear appreciation of their respective therapeutical properties.

Cypripedin.—This preparation, named on the catalogues of the manufacturers of eclectic remedies, is generally described as an oleoresin; it is directed to be prepared by the precipitation of a concentrated tincture of the root of Cypripedium pubescens, yellow ladies' slipper root, by adding it to water. It is given in doses of half a grain to three grains as an antispasmodic and anodyne. Ten grains are mentioned as a maximum dose of Keith's preparation, which is stated to be composed of a "resinoid and a neutral principle."

Dioscorein is a resinous extract, prepared from a saturated tincture of the root of Dioscorea villosa, wild yam, by adding it to its weight of water and distilling off the alcohol, when the precipitate remaining in the water may be collected, dried, and pulverized; this process, which is the same as for other resinous extracts, yields a product described in King's *Dispensatory* as a light yellowish-

brown powder, growing darker by age, deliquescent, of a faint smell and slightly sweetish, resinous, very bitter, acrid, and persistent taste. Like some other resinous extracts, it is much more soluble in alcohol when fresh than after long exposure. This preparation is said to be a valuable antispasmodic remedy, especially useful in bilious colic, in which disease Dr. King believes it to be as much a specific as quinia is in intermittent. It is given in doses of 1 to 4 grains every ten or twenty minutes in colic; also variously combined in some forms of uterine disease, and in combination with extract of Cornus cericea to overcome the vomiting of pregnancy.

Euonymin is an empirical preparation, issued by one of the manufacturers of eclectic remedies, of which the mode of preparation is not published. It is a product from the bark of Euonymus Americanus, and is represented as consisting of a "resinoid, a neutral, and an alkaloid principle," and as possessed of tonic, laxative, alterative, and expectorant properties. DOSE, from $\frac{1}{4}$ to 4 grains.

Eupatorine and Eupurpurin, prepared, according to King, from eupatorium purpureum, differ somewhat in their mode of preparation and properties, though, according to the published process, both are precipitated from the alcoholic solution; the former by an equal bulk of water acidulated with muriatic acid, and the latter by twice the bulk of water alone. Eupatorine, as prepared by J. B. Robinson, of Cincinnati, is described as a solid dark-brown resin, with a peculiar slighly aromatic odor, and a slightly bitter taste; though readily pulverizable, it rapidly runs into a mass, which blackens by age; it is soluble in ammonia and potassa, and is precipitated of a lighter color from the latter solution by muriatic acid. Its therapeutic properties seem rather undetermined. Tilden & Co. prepare eupatorine from Eupatorium perfoliatum, and give the dose as from 1 to 2 grains as a tonic diaphoretic, while eupurpurin is made from E. purpureum, and prescribed as a diuretic in doses of from 3 to 4 grains.

Eupurpurin, of Merrill, is stated by him to be an oleoresin, of a thick pilular consistence, of a dark greenish-brown color, having a faint peculiar smell, and a slightly nauseous taste; soluble in alcohol and ether and in oil of turpentine, from which ether precipitates the resin, holding the oily portion in solution, and on the addition of alcohol, the resin is redissolved; it is almost completely soluble in alkalies, but completely so on the addition of a small quantity of ether. This is prescribed in doses of 3 grains, repeated every three or four hours, as a powerful diuretic.

Dr. Coe repudiates the nomenclature of Tilden and the Cincinnati eclectics in case of two or more plants from the same genera yielding concentrated remedies, and prefers to call that from eupatorium perfoliatum, eupatorin (perfo) and that from E. purpureum, eupatorin (purpu). To the concentrated remedies issued under these names by B. Keith & Co., he attributes very different properties, though each is said to be a mixture of three principles—a "resinoid, neutral, and alkaloid." Although the E. (purpu) is recommended by Coe as a diuretic, and as useful in gravel, he does not mention

it as a powerful diuretic, but considers its powers as more directly alterative; he says it operates in dropsy by reason of its stimulant influence on the absorbents, as well as by its powers as a diuretic.

Euphorbin, derived from the root of Euphorbia corollata, is one of the so-called "concentrated medicines," made in New York, and recommended as an emetic, cathartic, diaphoretic, expectorant, and vermifuge. The dose is 1 grain or less.

Fraserin, derived from the root of Frasera Carolinensis, American colombo, consists, according to Dr. Coe, of a resin, a neutral principle, and a "muci-resin;"!! its properties tonic, stimulant, and mildly astringent; its dose from 2 to 10 grains.

Gelsemin is the name given to a "concentrated remedy" prepared by B. Keith & Co., from the root of one of the most beautiful indigenous products of our Southern States, *Gelseminum sempervirens*, yellow jessamine. Tilden & Co. prepare a "resinoid" from the same root, under the name of *Gelseminin;* neither of these preparations is brought within the range of legitimate practice by the publication of the formula for their preparation, nor are physicians even assured of their actual chemical and physical characters. Like many other medicines of their class, they are presented for our adoption solely on the personal guarantee of their respective manufacturers that they represent the drug from which prepared, and however high the estimate physicians may place upon the knowledge, skill, and integrity of their respective manufacturers, and the judgment of the few physicians who have published the results of their experience in the use of the preparations, the medical and pharmaceutical profession universally feel a proper hesitation in adopting any remedy the preparation of which is confined to a single house, of whose processes they are not allowed to judge, and whose preparations are not thrown open to the results of free competition and scientific criticism.

Gelsemin is recommended in doses of from $\frac{1}{4}$ to 2 grains in fevers, pneumonia, pleuritis, hysteria, amenorrhœa, and dysmenorrhœa, etc., and the popularity of this root, and the scarcity of well-known preparations of it, have given this currency among physicians.

Geranin or *Geraniin* is prepared from the root of Geranium maculatum, cranesbill, or crowsfoot, a well-known indigenous astringent. The process described in King's *Dispensatory* is similar to that for preparing podophyllin and other resinous extracts, though it would seem that the most important constituent of the root, tannic acid, from its ready solubility in water, would be lost by this method of preparation. Dr. King says that "many manufacturers prefer making it by evaporating an aqueous decoction of the root to dryness and evaporating," a process which would yield the tannin. The dose indicated in the books is from one to five grains.

Hamamelin is the name of a preparation from the root of witch-hazel, Hamamelis Virginica; its principal utility seems to be as an astringent, of which we have an immense number in use. Dr. Coe states that it also possesses sedative powers. The dose is 5 grains.

Helonin, derived from Helonias dioca, false unicorn root, is a so-

called neutral principle, employed in eclectic practice as a uterine tonic, used in *prolapsus uteri*, and diseases peculiar to females, and "to remove the tendency to repeated and successive miscarriage." DOSE, ½ grain to 2 grains. It is recommended as a vermifuge in 4-grain doses.

Hydrastin is the name applied in commerce to a yellow crystalline precipitate, produced on the addition of muriatic acid to an infusion of hydrastis Canadensis, golden seal or yellow puccoon root, a plant of the family Ranunculaceæ. The true nature of this precipitate was not suspected till in the number of the *American Journal of Science and Arts* for January, 1862, Prof. F. Mahla, of Chicago, announced the discovery that the so-called hydrastin is *muriate of berberina*. The vegetable alkaline salt, under the name hydrastin, is extensively used as a tonic remedy, especially adapted to treating dyspepsia and chronic inflammation of the stomach, and is said, combined with bitters, to have the effect of gradually removing the abnormal condition of the stomach in cases of intemperance, and in many instances of destroying the appetite for liquor. The dose for an adult is 3 to 5 grains, repeated three to six times a day.

The existence of another alkaloid in this root, the true *hydrastia*, was discovered by A. B. Durand, of Philadelphia, in 1850, and announced by him in the *American Journal of Pharmacy*, vol. xxiii. p. 113. The reader is referred to the chapter on Vegetable Alkalies, in Part IV. of this book, for further account of these principles.

Iridin is classed as an oleoresin by the Cincinnati School of Eclectics, though under the name *Irisin* a different preparation is made in New York. Both are derived from the root of Iris versicolor, blue flag, and recommended as possessed of alterative, sialagogue, laxative, diuretic, and anthelmintic properties. DOSE, from ½ grain to 5 grains.

Juglandin is a laxative, diuretic, and in larger doses cathartic agent, prepared from the bark of the root of Juglans cinerea, butternut, or white walnut. The process is identical with that given for the other precipitated resinous extracts. It is said to be nearly soluble in alcohol, and completely in ammonia and potassa, being precipitated from its solution in alkalies by muriatic acid. The dose is from 2 to 5 grains; combined with leptandrin, in pills of 2 to 4 grains each given after eating, it is highly recommended by eclectic authors for chronic hepatic disorders and constipation.

Lupulin.—The preparation of a "concentrated remedy" from hops is the undoubted right of any manufacturer, but we protest against the appropriation of the well-known and recognized name of a drug by which it is universally known in commerce and in the *Pharmacopœia* to designate a proprietary preparation. We have had a prescription for lupulin in combination, which we have ascertained from the physician issuing it was meant to designate this peculiar preparation, and although, as pharmacists, wedded to no exclusive views, we were disposed to furnish the medicine intended, we should certainly have been held blameless if we had dispensed an officinal article when ordered by its appropriate officinal name.

The lupulin of Keith, Tilden, and perhaps other manufacturers is a mixed resinous material, prepared by an unpublished process; it is prescribed in doses of from 5 to 10 grains.*

Lycopin is represented as astringent, styptic, sedative, and tonic; it is derived from Lycopus Virginicus (bugle weed), and is highly recommended by Dr. Coe in hemorrhages, diabetes, dysentery, and cardiac affections. Dose, 2 or 3 grains.

Leptandrin.—This is an impure "resinoid," obtained from the root of *Leptandra Virginica* (black root), an indigenous plant, formerly, but not at present, officinal in the *U. S. P.* It is prepared like the foregoing, using high proof alcohol for the extraction of the root, as a small proportion of water present in the tincture prevents its successful precipitation. The character of the precipitate is also affected by the temperature, which should not exceed 180° F. Roots of the second year's growth are said to yield the most of this product.

Leptandrin, as thus prepared, is of a gray or brown color, with a peculiar faint odor and taste. Like most of these preparations, it is generally sold in powder. Though at first soluble in alcohol, it becomes less so by age; it dissolves in solution of ammonia and potassa, from which acids throw it down.

B. Keith & Co., of New York, claim for leptandrin, of their manufacture, that it contains four distinct principles, "resin, resinoid, alkaloid, and neutral." In view of the fact, ascertained by Prof. E. S. Wayne, that this root contains a bitter crystalline principle, soluble in water, it would seem that the method of precipitation by water from a concentrated tincture would fail to secure a preparation representing the full therapeutic power of the drug, but in the absence of any information in regard to the process of Keith, or any analysis of his preparation, it is impossible to tell how far it meets the requirements of a preparation representing the root from which it is prepared.

The remedy is highly valued by many practitioners as a cholagogue or stimulant to the hepatic secretion, without so decided a purgative action as usually pertains to that class of remedies; it is highly recommended in chronic dysentery and diarrhœa, and in typhoid and other fevers; according to Dr. Coe, it possesses the advantage of being a tonic, which invigorates while it deterges. Like podophyllin, it is a leading article of production with several large manufacturing pharmacists in the United States. The dose is two to four grains.

Menispermin is prepared by Keith & Co. from Menispermum Canadense, yellow parilla, but, no formula being published, and no analysis having been made, it is only prescribed by those who are prepared to accept medicinal agents on trust. It is said to be an alterative, tonic, laxative, diuretic, and stimulant, in a medium dose of two grains. (*See* Vegetable Alkalies.)

Myricin.—The published formula of Dr. Hill & Co. for this

* See Extract of Lupulin.

remedy exhibits a departure from the usual method of preparation of the class, which appears to be an improvement. A saturated tincture of bayberry bark (Myrica cerifera), being evaporated by a water-bath until of a syrupy consistence, is spread in thin layers on glass plates till dried by spontaneous evaporation, requiring several weeks.

This is then an alcoholic extract, carefully dried to a pulverulent condition, which, as the bark does not appear to possess important volatile or readily oxidizable constituents, gives a convenient representative of the soluble principles of the bark. It is a stimulant and decided astringent, and is asserted to possess alterative, diuretic, and antispasmodic properties. DOSE, 2 to 10 grains.

Phytolaccia, *Phytolaccin*, is a concentrated remedy from poke root (Phytolacca decandra). No process is published for its preparation, and it is not made by all the "eclectic" pharmacists, nor recommended by all the authors of that school. It is said to be a light-brown powder, soluble in water and insoluble in alcohol or ether, and to be alterative, aperient, and slightly narcotic. DOSE, from one-fourth of a grain to a grain three times a day.

Populin, from the bark of Populus tremuloides, aspen, or American poplar, is recommended by eclectics as a tonic and febrifuge; and Dr. Coe attributes to it numerous valuable properties alone and in combination. DOSE, 4 to 8 grains.

Prunin, a "concentrated remedy" prepared from wild cherry bark, Cerasus serotina, by the same manufacturers, finds no favor with the author of the *American Dispensatory;* Dr. Coe, however, claims for Keith's preparation that it contains three principles, "resinoid, neutral, and amygdalin," of which the neutral principle is the long-sought active constituent of the bark. It is, of course, destitute of hydrocyanic acid, though stated to be stimulant, tonic, expectorant, and in large doses, *sedative.* The dose as a tonic is 2 grains, as an expectorant 1 to 2 grains, as a sedative 4 to 8 grains. We have no process for nor analysis of this and many of the preceding preparations, and little or no impartial testimony as to their merits. Like many others of their class, they are introduced in this work from no design to recommend them, but for the necessary information of physicians and pharmacists who meet with them in the course of their professional practice.

Ptelein.—Prepared from the bark of the root of Ptelea trifoliata, wafer ash, by adding a saturated tincture to twice its volume of water and distilling off the alcohol, when the ptelein remains as a soft oleoresinous precipitate, of a dark-brown color, a peculiar odor, and an oily, bitter, acrid, persistent taste; soluble in alcohol, ether, and oil of turpentine, and imperfectly in alkaline solutions. It is recommended as a tonic, and, in combination with various other remedies, has been used in dyspepsia, hepatic torpor, chronic erysipelas, and chronic dysentery.

Rhusin.—The account of this substance, given by Dr. King in his *Dispensatory*, taken from the *Eclectic Journal of Medicine*, Rochester, vol. iv., No. vi., p. 232, is one of the most curious instances

of the inaccuracy of many of the processes and descriptions of the eclectic works. It is represented to be the active principle of the leaves of *Rhus glabrum*, sumach, which are to be percolated by alcohol of sp. gr. .830, and this displaced by means of a vacuum apparatus. "The rhusine is then precipitated and washed with distilled water, dried on filter cloth in an airy, dry room, and reduced to a fine powder." It is said to be a "light brown powder, *soluble in hot water*, insoluble in alcohol, and having a slightly bitter taste."

The reader will observe that a precipitate thrown out of solution in alcohol by water is, when dried, said to be soluble in hot water and insoluble in alcohol. If this were the only instance of similar inconsistency, it might be attributed to carelessness in the compiler, or incompetency in the proof-reader. The well-known existence of tannic and gallic acids in large proportion in the leaves of sumach, renders it impossible that a preparation representing their medical properties could be prepared by the process above quoted. The rhusin of Keith & Co. is stated to be from the bark of the root, and to contain resinoid and neutral principles; tannin is not mentioned, and yet the remedy is esteemed tonic, astringent, and antiseptic.

Rumin is a concentrated preparation from yellow dock root, Rumex crispus. The formula is not published. The manufacturers attribute alterative, mildly astringent, and laxative properties to it, and assert that it resembles rhubarb. It is generally prescribed in combination. Average dose, 3 grains.

Rhein.—One of the "eclectic" manufacturers has, of late, attempted the application of his unpublished modes of preparation to rhubarb root, with what success we do not know. The dose, as given by Dr. Coe, is from 1 to 4 grains.

Scutellarine, *Scutellarin.*—The formula of Prof. C. H. Cleaveland is as follows: Make a tincture of the herb scutellaria lateriflora with alcohol of 76 per cent., distil off the alcohol until the liquid is of the consistence of a fluid extract, add to it several times its weight of water, and precipitate with solution of alum. Wash the precipitate to free it from the alum, and dry it in the open air without heat. This process furnishes an extractive material of a light greenish-brown color, partially soluble in alcohol and more so in ether; insoluble in water. Its medical properties are those of a nervine and tonic. Dr. King considers it especially useful in cases of depression of the nervous and vital powers after long sickness, over-exercise, excessive study, or from long-continued exhausing labor. Dose, from 2 to 6 grains.

Sanguinarina and *sanguinarin* are two very different preparations, from the root of Sanguinaria Canadensis (bloodroot), which belongs to the natural family *Papaveraciæ*, the poppy tribe. Of the alkaloid *sanguinarina* mention is made in Part IV. It is a powerful remedy, being used in doses of one-tenth to one-thirtieth of a grain, and should be carefully distinguished from the so-called "alka-

resinoid," which is chiefly used in the eclectic practice, and which contains an uncertain proportion of it.

Sanguinarin is thus prepared: Take of bloodroot, in coarse powder, a convenient quantity, and alcohol sufficient; make a saturated tincture, as in the case of the other "resinoids;" filter and add an equal quantity of water; distil off the alcohol and allow the residue to rest until precipitation ceases. Remove the supernatant liquid, wash the precipitate in water, dry it carefully by moderate heat, and pulverize it for use. As thus prepared, the powder is of a deep reddish-brown color, peculiar odor, and bitter, rather nauseous taste, followed by a persistent pungency on the fauces. It is insoluble in water, soluble in boiling alcohol, and partially soluble in alkaline solutions, acetic acid, and ether. This is given as a tonic in doses of from $\frac{1}{4}$ to 1 grain, and as a hepatic and alterative from $\frac{1}{2}$ a grain to 2 grains.

Senecin, the "concentrated active principle" from *Senecia gracilis*, precipitated from a saturated tincture of the root and herb, by adding it to an equal bulk of water and distilling off the alcohol. It is called an oleoresin by Dr. King, but is sold in powder by some manufacturers who mix it with dry materials to give it this character. The dose, as a diuretic, emmenagogue, and expectorant, is from 3 to 5 grains, but it would seem that dilution with an inert powder would modify the quantity required to produce a given effect.

Senecionine is a modification of the foregoing, directed to be prepared, according to Dr. F. Hill, by adding two or three times its weight of water to the tincture, evaporating to the consistence of a fluid extract, and further precipitating with a solution of alum, washing, and drying without heat; it forms a dark-green powder, which may be given, as the representative of the plant, in doses of from 1 to 5 grains.

Stillingin is advertised as the active principle of Stillingia sylvatica, Queen's delight, a plant indigenous to our Southern States. The process for its preparation is concealed. Dr. King, in his *Dispensatory*, asserts that the specimen he has seen is, undoubtedly, the preparation known as oil of stillingia, triturated with sugar or sugar of milk. The oil of stillingia is made by treating the root with 95 per cent. alcohol or with ether, and evaporating off the menstruum. It is not a uniform liquid, but is liable to deposit flocculi on standing. According to Dr. King, it contains about 40 per cent. of fixed oil, the remainder consisting chiefly of extractive matter and resin. Externally applied, it is recommended as a valuable stimulating application, too acrid for internal use, unless incorporated with viscid ingredients and largely diluted. Dr. Coe gives it in doses of 1 drop, which he repeats every half hour in croup, or in bronchitis and laryngitis, every four or six hours, incorporated with mucilage or dropped on sugar.

Smilasin is the name applied to a preparation of sarsaparilla, lauded in the work of Dr. Coe. I confess to incredulity about its merits, though founded on no experiment or positive information.

The dose is 2 to 5 grains. It must, of course, be distinguished from the neutral crystalline principle obtained from sarsaparilla, and resembling saponin. *See* chapter on Neutral Crystalline Principles, Part IV.

Trilliin, a "concentrated medicine" extracted from Trillium pendulum, bethroot, is represented as an astringent, tonic, alterative, and expectorant, in doses of 4 to 8 grains. It must not be confounded with *trilline*, a neutral acrid principle, resembling saponine, isolated from this root by Prof. E. S. Wayne.

Viburnin is the name applied by one of the "eclectic" manufacturers to a secret preparation, said to be obtained from the bark of Viburnum opulus, and recommended as an antispasmodic, antiperiodic, expectorant, alterative, and tonic, in doses of 2 grains.

CHAPTER XV.

ON DISTILLATION, DISTILLED PRODUCTS, AND PERFUMERY.

The process of distillation, the reverse of evaporation in its applications, is, like it, designed to separate the volatile from the fixed ingredients in a solution. While in evaporation the object is to dissipate and reject what is volatile, preserving and retaining what is comparatively fixed, in distillation the volatile ingredient is to be secured. To distil a solution, it is first converted into vapor by the application of heat, and the vapor is then condensed in a separate part of the apparatus.

In a work of the design and scope of the present, any elaborate description of the apparatus used in distillation, and the mode of conducting the process on a large scale, would be quite superfluous. The uses of the still in the manufacture of spirituous liquors, spirit of turpentine, and coal oil of commerce, and in the rectification of these, and of petroleum, and in various other branches of manufacture, are among the most important subjects connected with chemical technology, and occupy a prominent place in works on that subject.

The reader is referred to papers upon this subject, describing stills suitable for the use of pharmacists, in *Amer. Journ. Pharmacy*, vol. xxxvi. 12, 22, xxxvii. 166, xli. 197; those desirous of obtaining information respecting stills for rectification of spirits can consult Muspratt's *Chemistry*, subject Alcohol, and a paper by Dr. E. R. Squibb, in vol. xxx. page 1, of *Amer. Journ. Pharmacy*.

It should be remembered in performing distillations that the largest quantity of liquid that can be drawn off in a given time is not to be regarded as the most desirable result; the sp. gr. of the spirit obtained must also be considered. If the heat be too great, more of the less volatile portions will pass over and the distillate

be less desirable for future use, while the liquid remaining in the still will be objectionably strong in spirit. For this reason the refrigeration must be attended to. The condensation of liquids of alcoholic or ethereal character should be conducted at such temperatures as will permit the less volatile matters associated with them to flow back to the still while the stronger spirit passes on, to be fully refrigerated, and then kept for the use designed. Without thorough refrigeration great loss of material must necessarily occur, and serious accidents have happened from the vapor of volatile liquids impregnating the apartment in consequence of deficient refrigeration.

In the chapter preliminary to the treatise on pharmaceutical chemistry, Part III., the forms of apparatus adapted to the purposes of the pharmacist in his more strictly chemical processes are described and figured; in the present chapter only such apparatus is figured and described as is adapted to the preparation of distilled spirits and waters, and the recovery of alcohol from evaporating tinctures.

Fig. 239.

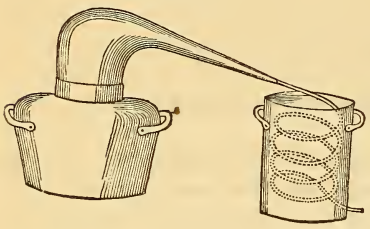
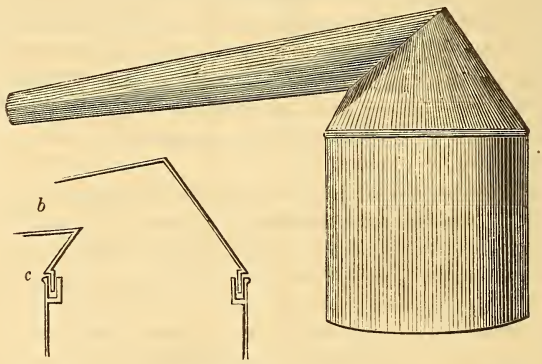


Fig. 239 exhibits a copper still and block-tin condensing worm, such as may be conveniently used for the distillation of liquids which are not liable to corrode metallic vessels. Such an apparatus is particularly adapted to distilling water for pharmaceutical use, also rose-water and the alcoholic solution of essential oils, called spirits. If of sufficient capacity, it is adapted to the distillation of essential oils. The chief obstacle to its general use for the various purposes of the pharmacist lies in the comparative difficulty of depriving the

Fig. 240.



Tin retort with water joints.

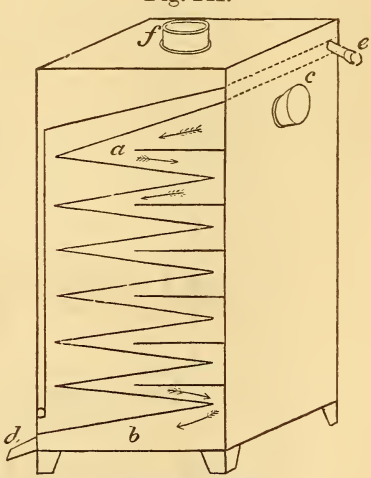
condensing worm of the odor of different substances distilled and the consequent liability of these to contaminate the next succeeding distillate.

Fig. 240 represents a vessel of tinned iron which I have used as a substitute for a glass retort in operations in which no corrosive or acid substance enters into the liquid to be distilled. Near the top of a deep tin vessel is soldered on a small gutter, so arranged on its inside as not to reach quite up to the level of the sides of the vessel. The top, *b*, has a rim projecting downwards, which sets into this gutter, as shown at *c*, in the section. When about to use this, after charging it with the substance to be distilled, the little gutter is filled with water and the top fitted on. The water joint thus formed prevents the escape of any portion of the vapor, while it is prevented from becoming empty by the moisture condensed on the inside of the conical top dropping into it as it descends.

This may be used in connection with any means of refrigeration at hand, such as a worm and tub, or a Liebig's condenser figured in the first chapter on Pharmaceutical Chemistry. Among its advantages are the absence of bumping, a phenomenon which interferes with the use of glass retorts, and its freedom from the liability to fracture. In using it, however, care must be taken to withdraw the heat as soon as the required quantity of liquid has been distilled; otherwise the solid contents, becoming caked on the bottom of the retort, will give rise to empyreumatic products, contaminating the distillate.

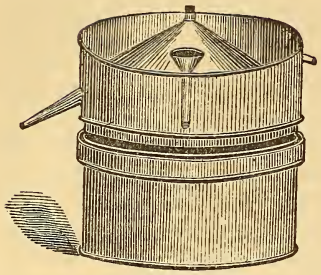
Fig. 241 shows a cooler which may be attached to any still-head or retort, and is especially applicable to the condensation of alcoholic vapor; it consists of a square box of tinned iron, twice the height of its diameter, with a diaphragm soldered on diagonally so as to be lower at one corner than at the other three. At this lowest corner a vertical tube is soldered in the diaphragm, which descends in that corner of the box nearly to a lower diaphragm. Between this diaphragm and the upper one the space is separated into equal parts by a series of transverse partial partitions or plates, meeting alternately at acute angles, within an inch of the opposite sides of the box, so as to separate the water for condensing, which passes down through the tube and gradually fills one side, from the condensing surface and space for the vapor, which enters at a conical neck *c* just below the upper diaphragm; a series of plates are soldered to the side penetrated by the neck so as to extend into the condensing space and compel the vapor to take a zigzag course, as indicated by the arrows. As the coldest part of the condensing surface is

Fig. 241.



Warner's condenser.

Fig. 242.



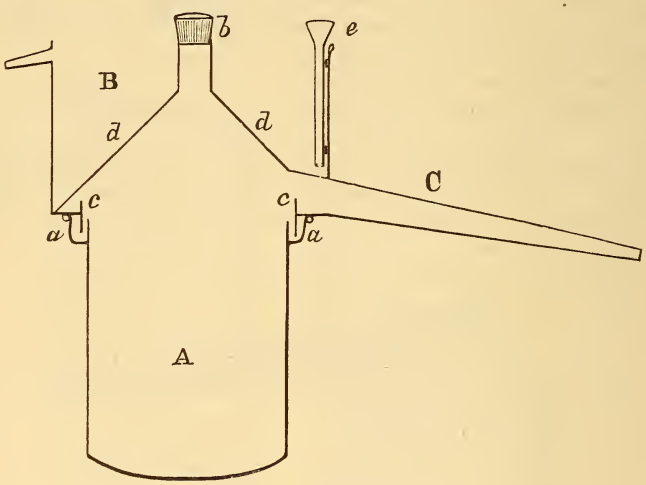
Pharmaceutical still.

near the bottom, the vapor is thoroughly condensed in its course through the apparatus; the cold water entering at *f* is discharged warmed at *e*, the distillate finds an outlet at *d*.

The pharmaceutical still, invented by Prof. Procter, is a cheap and very convenient apparatus for the uses now under consideration; it is well adapted to recovering the alcohol from tinctures to be made into syrups, fluid extracts, or extracts; the alcohol obtained, even though impure and below standard strength, is suited to preparing the same tincture again; and the saving of alcohol by this means will be very considerable.

It may be made of tinned iron, but preferably of tinned copper, of any required size from a gallon up to five or even ten gallons capacity; the condenser is in this case immediately over the boiler in which the liquid is heated, and the distillate is collected by means of a ledge or gutter on its lower surface. Fig. 243 represents a sec-

Fig. 243.



Section of pharmaceutical still.

tion of this still. *A* is a deep tin boiler, with a rim soldered round its top at *a a*, forming a gutter for the water joint, by which it is connected with the dome or head *B*. This is the refrigerator, on the inner surface of which the condensation occurs; *C* is the neck or tube for carrying off the distillate; *c c* is a circular rim soldered on to the base of the head *B* in such a position that the upper projection forms a gutter for conducting the condensed fluid as it runs down on the under surface of the cone *d d* into the neck *C*,

while the lower part projects downward into the gutter *a a* to form the water joint.

The course of the circular rim *c c* is of necessity inclined downwards towards the under edge of the neck *C*, as indistinctly shown in the section, in order to determine its liquid contents in that direction.

b is an opening in the top of the condenser, stopped by a cork, for inspecting the progress of the distillation, and adding to the contents of the boiler; *e* is a funnel tube into which a current of cold water is directed during distillation, while as it becomes warm it ascends and escapes by the tube on the other side. The water joint is to be nearly filled at the commencement of the operation, and effectually prevents the escape of the vapor. It is important that the inner rim which forms part of the water joint be kept lower than the outer one, so that any liquid which is added by condensation to the water in the joint shall flow back into the still.

The long-continued application of a pretty high heat, which is necessary in distillation, involves an expense which, if gas or even charcoal fuel is employed, may approach the value of the alcohol recovered, so that in the winter time it is well to avail ourselves of the stove used for heating the apartment by fitting the still to it, and distilling slowly at the moderate heat thus obtained. The advantage gained by the exclusion of the atmosphere in distillation is not to be overlooked when vegetable preparations are being concentrated. The head of the still becoming full of steam excludes the air, for the most part, and the condensation of the steam brings about a partial vacuum which favors evaporation at low temperatures.

The proper refrigeration of the condensing surface requires pretty free use of cold water; and the application of this has direct relation to the degree of heat required to vaporize the liquid being distilled. An indication by which the operator may always judge when the refrigeration is insufficient, is the escape of uncondensed vapor. When this is observed, he should diminish the heat applied, and increase the application of cold to the condensing surface; this precaution is very important when the vapor is inflammable. The methods indicated in Part III. for the continuous application of cold water by a funnel, and by a small cock, near the bottom of a tin bucket, are also well adapted to the kinds of apparatus now described. In using this still I have usually conducted the operation by the use of a movable gas stove, Fig. 127, on a counter, at the end of which are a sink and hydrant; by the use of a few feet of elastic tube, the cold stream from the hydrant may be determined into the cooler, while the warmed water is conducted off into the sink by a similar attachment.

The application of heat must of course be regulated by the volatility and inflammability of the liquid treated. Strong alcoholic or ethereal liquids, being volatilized at low temperatures, may be heated by a water-bath or a sand-bath, not too hot, which, besides

preventing the excessive boiling of the liquid, will diminish the danger from fracture if a glass vessel is used.

In distilling from flowers or herbs for obtaining essential oils or medicated waters, there is great liability to scorching from the contact of masses of the solid material with the heated surface of the still, thus producing empyreumatic products which quite destroy the agreeable fragrance of the product. A false bottom or perforated diaphragm, a few inches above the point of contact with the flame, is a preventive of this, adopted in large operations. In some cases even this is not sufficient, and, as in preparing oil of bitter almonds, it will be found necessary to introduce the pulpy mass upon a layer of straw over the bottom or upon a diaphragm; by this means the contact of the material with the spot where the heat is applied is effectually prevented. The application of carefully regulated steam heat is, of course, in this as in most other heat operations on a large scale, a great improvement.

Distillation is frequently applied to obtain products for the perfumer, and, in some instances, particularly those of the fragrant waters, the terms double distilled and triple distilled are frequently used; the meaning being that the same liquid has been twice or three times distilled from separate fresh portions of the flowers.

Galenical Preparations made by Distillation.

Aquæ Destillata, U. S. P. (*Distilled Water.*)

This is directed to be used in a great many preparations in the *Pharmacopœia.* In some, its employment seems called for, while in others, the river or spring water, so freely supplied in nearly all towns and cities, answers every purpose.

The inorganic impurities imparted to spring waters by the rocks through which they permeate are in the highest degree important in connection with solutions of delicate chemical substances, and the same may be said of the organic substances which contaminate some of the natural sources of water, and form precipitates with nitrate of silver, tartrate of antimony and potassium, and a few other very delicate chemical agents. It is, however, generally sufficient that water should be pure enough for safe and wholesome drinking to be fit for use in preparing the Galenical and even many of the chemical preparations.

One of the most important uses, to the apothecary and physician, of the apparatus for distillation figured and described on the foregoing pages, is to enable him to prepare, and keep at hand for special occasions, *aqua destillata.*

Aquæ Medicatæ.

Under the head of Medicated Waters, Chapter IV., it has been stated that most of this class of preparations may be made by the solution of the essential oils in water, or preferably by the distillation of water from the flowers or other odorous parts of plants which contain the essential oils in their fresh and unchanged condition.

Perhaps the most important case of this kind is *aqua cinnamomi*, which, as before stated, when made by the distillation of water from the true Ceylon cinnamon, is one of the most delicious of flavors, and besides the peculiar odor of the cinnamon is pleasantly sweet to the taste, a property which must be due to some volatile ingredient at present unknown. The proportion of true cinnamon to the water used is 18 troyounces to the two gallons. The bark should be coarsely powdered and macerated some hours before applying the fire, and from the two gallons only one gallon is recovered.

Aqua rosæ is one of the medicated waters in most common use, designed to be made by distillation, and prescribed as a solvent for salts which are incompatible with chemical substances often present in minute quantities in water from springs and rivers. It is, however, very liable to undergo spontaneous changes which render it unfit for use. 3 lbs. and 5 oz. *com.* of rose petals are directed to two gallons of water, from which one gallon is to be collected. The rose petals collected in season may be preserved in salt till needed.

Aqua aurantii florum is also directed to be made in the same manner.

Fennel water, *mint water*, and *peppermint water* are all indicated in the *Pharmacopœia* as adapted to this mode of preparation, the proportion indicated being 18 troyounces (1¼ lbs. com.) to two gallons, from which one gallon is to be distilled; while anise water is directed to be made with ten troyounces to two gallons, from which one gallon is to be distilled.

Olea Destillata, *U. S. P.*

The distilled oils are prepared by mixing the bruised herb or other part containing the oil with a small portion of water in a still, when, after macerating for a suitable length of time, and adjusting the apparatus, heat is applied. The oil, though its boiling point is always much above that of water, is readily diffused in the steam; and when this is condensed in the refrigerated part of the apparatus, the oil, if in excess, separates, and if specifically lighter collects on the surface of the distilled water; or, if heavier, it settles to the bottom, and may be separated. The mode of preparing the officinal *aqua rosæ*, and other common distilled waters, corresponds with this, the proportion of water being so adjusted that no excess of the oil beyond what is soluble in the water shall be present.

Spiritus, *U. S. P.*

Alcoholic solutions of essential oils are usually called spirits or essences; they are sometimes prepared by distilling alcohol from the fresh herb, which thus gives up its essential oil, and on condensation retains it in solution. In the last edition of the *Pharmacopœia* (1870) this method of making the spirits lavand. and nutmegs was dropped. This is to be regretted, as the spirits obtained by

distillation, as has been already observed, are much more free from resinous and terebinthinate flavor than those made by solution. They are also prepared by dissolving the oil directly in alcohol, as in the spiritus menthæ piperitæ, spiritus menthæ viridis, called essences of peppermint and spearmint, and spiritus camphoræ. For the preparation of all spirits by solution, fresh volatile oils ought to be selected, to impart the flavor in its purity; old resinified oils should be rejected for this purpose, or, if used, should be purified by redistillation, with the previous addition of a little water. The greater portion of the class spiritus are merely solutions of the essential oil in alcohol.

In the edition of the *Pharmacopœia* for 1860, several preparations were added to this series which were formerly classed among the chemicals. *Spiritus ætherus compositus*, *spiritus ætherus nitrosi*, *spiritus ammoniæ*, *spiritus ammoniæ aromaticus*, and *spiritus chloroformi*, are of this description. The reader is referred to the chemical part of this work for a description of these. The following syllabus displays those which do not belong to any chemical series.

Spiritus, U. S. P.

Solutions of essential oils.

Officinal name.	Proportion.	Use.
Spiritus anisi	Oil f℥j, alcohol .817 f℥xv	Carminative.
" camphoræ	f℥ij, " .835 f℥xvj	Antispasmodic, nervous stim.
" cinnamomi	Oil f℥j, " .817 f℥xv	Aromatic, carminative.
" juniperi	" f℥j, " .817 f℥xlviij	Carminative, diuretic.
" " com.	" juniper f℥iss, caraway, Fen'l, ea. ♏x } alcoh. Ov water Oiij	" "
" lavandula	" f℥j, alcohol .817 f℥xlviij	Stimulant, aromatic.
" " comp	See formula	Stim., aromatic, carminative.
" limonis	" f℥ij, lemon-peel ℥j, alcohol .817 f℥xxxij	Flavoring adjuvant.
" menthæ piperitæ	" f℥j, alcohol .817 f℥xv	Carminative.
" " viridis	" f℥j, " .817 f℥xv	"
" myristicæ	" f℥j, " .817 f℥xlviij	Flavoring adjuvant.

The *uses* of this class are familiar to most; they are chiefly used as flavoring ingredients of various preparations, and this use is also connected in some cases with medical properties. *Comp. spirit of juniper* is a close approximate to Holland gin, and may take the place of *schiedam schnapps* as a stimulating diuretic. The other spirits are mostly the kind of stimulants conveniently designated as carminatives.

The simple *spirit of lavender* prepared by distillation is one of the most pleasant of perfumes. That made by solution from the recipe to be given hereafter is dependent on the freshness and fine quality of the oil for its value as a perfume. The cultivated or garden lavender yields a much better oil than the common wild plant; the finest quality oil of garden lavender comes from England, and commands a high price. The next in quality is of French origin, dis-

tilled by A. Chiris, and is somewhat cheaper, though not identical in flavor.

The only preparations of this series which are much prescribed are *compound spirit of lavender and spirit of camphor*. The former is very often directed by practitioners as a flavoring and coloring ingredient in prescription. The choice of saunders as the coloring agent is, however, unfortunate from the resinous deposit which is apt to separate by dilution with water and on long standing. Cochineal is a much brighter and handsomer coloring ingredient, and the compound tincture of cardamom is, on that account, to be preferred to the lavender compound as a coloring ingredient in solutions and mixtures. *Spirit of camphor* is made by solution of the camphor in alcohol; it is ill adapted for internal use, owing to its precipitating on being added to water. The dose when properly suspended is twenty drops.

Working Formulas for some of the Officinal Spirits.

Spiritus Anisi. (*Spirit of Anise.*) U. S. P.

Take of Oil of anise, a fluidounce.
Stronger alcohol, fifteen fluidounces.

Dissolve the oil in the stronger alcohol.

In the same way make *spiritus cinnamomi*, from oil of cinnamon.

Spiritus Camphoræ. (*Spirit of Camphor.*) U. S. P.

Tinctura Camphoræ, *U. S. P.* 1850.

Take of Camphor, four troyounces.
Alcohol, two pints.

Dissolve the camphor in the alcohol, and filter through paper.

Spiritus Limonis. (*Spirit of Lemon. Essence of Lemon.*) U. S. P.

Take of Oil of lemon, two fluidounces.
Lemon peel, freshly grated, a troyounce.
Stronger alcohol, two pints.

Dissolve the oil in the stronger alcohol, add the lemon peel, macerate for twenty-four hours, and filter through paper.

Spiritus Menthæ Piperitæ. (*Spirit of Peppermint.*) U. S. P.

Tinctura Olei Menthæ Piperitæ, *U. S. P.* 1850.

Take of Oil of peppermint, a fluidounce.
Peppermint, in coarse powder, one hundred and twenty grains.
Stronger alcohol, fifteen fluidounces.

Dissolve the oil in the stronger alcohol, add the peppermint, macerate for twenty-four hours, and filter through paper.

In the same way, make—

Spiritus Menthæ Viridis. (*Spirit of Spearmint.*) U. S. P.

From oil of spearmint.

Spiritus Myristicæ.

Take of Oil of nutmeg, a fluidounce.
Stronger alcohol, three pints.

Dissolve the oil in the stronger alcohol.

Spiritus Lavandulæ, U. S. P. (*Spirit of Lavender.*)

Take of Oil of lavender, a fluidounce.
Stronger alcohol, three pints.

Dissolve the oil in the stronger alcohol.

Spiritus Lavandulæ Compositus. (*Compound Spirit of Lavender.*) U. S. P.

Take of Oil of lavender, a fluidounce.
Oil of rosemary, two fluidrachms.
Cinnamon, in moderately fine powder, two troyounces.
Cloves, in moderately fine powder, half a troyounce.
Nutmeg, in moderately fine powder, a troyounce.
Red saunders, in moderately fine powder, three hundred and sixty grains.
Alcohol, six pints.
Water, two pints.
Diluted alcohol, a sufficient quantity.

Dissolve the oils in the alcohol, and add the water. Then mix the powders, and, having moistened the mixture with a fluidounce of the alcoholic solution of the oils, pack it firmly in a conical percolator, and gradually pour upon it the remainder of the alcoholic solution, and afterwards diluted alcohol, until the filtered liquid measures eight pints.

Spiritus Juniperi. (*Spirit of Juniper.*)

Take of Oil of juniper, a fluidounce.
Stronger alcohol, three pints.

Dissolve the oil in the stronger alcohol.

Spiritus Juniperi Compositus. (*Compound Spirit of Juniper.*) U. S. P

Take of Oil of juniper, a fluidrachm and a half.
Oil of caraway,
Oil of fennel, each, ten minims.
Diluted alcohol, eight pints.

Dissolve the oils in the diluted alcohol.

On Perfumery and Toilet Articles.

Among the uses to which the products of distillation are applied, those connected primarily with the sense of smell possess an interest and importance, especially to the pharmacist, who has, from the earliest time, been called upon to manufacture and sell them, which justifies the appropriation of a portion of this work to their modes of preparation.

Besides the use of fragrant essences for the mere gratification of the sense of smell, they serve a good purpose in headache, and as

grateful refrigerant applications in dry and hot conditions of the skin.

Although some of the finest perfumes are derived from the East Indies, Ceylon, Mexico, and Peru, yet we owe most of the supplies used in the perfumer's art to the extensive flower farms of Nice, Grasse, Montpellier, and Cannes, in France, and owing to the peculiar fitness of the climate of those provinces, and the adaptation of the French people to pursuits requiring delicate perceptions and refined tastes, the art of perfumery has attained a perfection in France towards which most of our manufacturers make but a faint approximation. The French recipes call for so many ingredients not readily obtained in this country, and altogether derived from their own gardens and manufactories, that they require considerable modification to make them practicable to us. I shall, therefore, confine myself to inserting a few tried recipes which constitute a pretty good assortment of essences.

Unlike the medicinal preparations spoken of throughout the other parts of this work, these perfumes allow of an unlimited choice of ingredients, and a corresponding variety of combinations and proportions, restricted only by that most capricious of all standards—*taste.*

For further accounts of the art of making fragrant essences and all other perfumes, see the admirable work on the subject by G. W. Septimus Piesse, published in London, and republished in Philadelphia, in 1856 and 1863.

Colognes.

Eau de Cologne, as imported from Cologne and from Paris, is a highly rectified spirituous perfume obtained by distillation from a variety of fragrant plants. Of the numerous Farina colognes imported, all are highly rectified and apparently distilled from the plants, while, as prepared in this country, Cologne water is almost always made from essential oils dissolved in alcohol. This may be very good, if the oils are fresh and combined with reference to their relative strength and accord.

Best Cologne Water. (*No.* 1.)

Take of	Oil of bergamot	f℥ij.
	Oil of neroli	f℥ij.
	Oil of jessamine	f℥ss.
	Oil of garden lavender	f℥ij.
	Oil of cinnamon	♏j.
	Benzoated tincture	f℥iij.
	Tincture of musk	f℥ss.
	Deodorized alcohol	Cong. j.
	Rose water	Oij.

Mix, and allow the preparation to stand a long time before filtering for use.

Common Cologne Water. (*No.* 2.)

Take of	Oil of lavender	f℥iss.
	Oil of rosemary	f℥ss.
	Oil of lemon	f℥j.
	Oil of cinnamon	gtt. xx.
	Alcohol	Cong. j. Mix.

Much cheaper than the foregoing.

Benzoated Tincture for Colognes, etc.

Take of	Tonqua beans	℥j.
	Vanilla	℥ij.
	Nutmeg, grated	No. j.
	Mace	℥ij.
	Benzoic acid	gr. x.
	Alcohol	Oj.

Macerate the solid ingredients, in coarse powder, in the alcohol *ad libitum*, and filter.

Toilet Waters.—(*Substitutes for Eau de Cologne.*)

Rose Geranium.

Take of	Essential oil of citronella (India)	f℥ij.
	Essential oil of lemon grass (India)	f℥ss.
	Essential oil of bergamot	f℥ss.
	Essential oil of lavender (French)	f℥ij.
	Extract of jessamine (from pomade)	f℥j.
	Benzoated tincture	f℥ij.
	Alcohol (95 per cent. deodorized)	Cong. j.

Mix and reduce with water which has previously been saturated with oil of citronella by trituration, after the manner of the officinal medicated waters, as long as it can be done without precipitating too much of the essential oils; let it stand for a few days and filter.

Orange Blossom.

Take of	Essential oil of neroli (petal bigarade No. 1)	f℥j.
	Essential oil of orange peel (bigarade No. 1)	gtt. xl.
	Essential oil of rosemary (from flowers only)	f℥ss.
	Essential oil of bergamot	f℥j.
	Extract of orange flowers (from pomade),	
	Extract of jessamine (from pomade), each	f℥ij.
	Alcohol (95 per cent. deodorized)	Oiv.
	Distilled orange-flower water	Oj, or q. s.

Mix, and proceed as before.

Putcha Pat. (*Patchouly.*)

Take of	Essential oil of patchouly	f℥ij.
	Essential oil of copaiva	f℥ss.
	Essential oil of orange-peel (bigarade)	♏v.
	Essential oil of valerian	♏ij.
	Essential oil of rosemary (from flowers only)	♏xv.
	Tincture of ginger	℥iss.
	Benzoated tincture	f℥ss.
	Alcohol (95 per cent. deodorized)	Cong. j.
	Patchouly water (made with oil of patchouly, after the method of medicated waters, as in rose geranium)	Oj, or q. s.

Rose.

Take of	Balsam Peru	♏xxv.
	Essential oil of bergamot	fʒiij.
	Essential oil of santal	♏xl.
	Essential oil of neroli (bigarade petal No. 1)	♏xx.
	Essential oil of rosemary (aux fleurs)	fʒiss.
	Essential oil of rose (kisamlic)	fʒij.
	Essential oil of citronella (India)	fʒiss.
	Extract of rose (from pomade)	fʒij.
	Alcohol (95 per cent. deodorized)	Ovj.
	Rose water (distilled)	Oj.

Add the last after the mixed oils and alcohol have stood two or three days, and filter the whole.

Lavender.

Take of	Essential oil of lavender (aux fleurs)	fʒiss.
	Essential oil of lemon	fʒiij.
	Essential oil of lemon thyme	fℨj.
	Essential oil of orange-peel, *sweet*	fʒj.
	Essential oil of nutmeg	fʒj.
	Essential oil of sage	fʒss.
	Tincture of musk	fʒvj.
	Tincture of benzoin	fℨj.
	Sweet spirit of nitre	fℨij.
	Alcohol (95 per cent. deodorized)	Cong. ss.
	Lavender water (made from the oil and water)	Oj.

Millefleur.

Take of	Balsam Peru	fʒiij.
	Oil of bergamot	fʒvj.
	Oil of cloves	fʒiij.
	Oil of neroli (*pet. gr.*)	fʒvj.
	Extract of musk	fʒiij.
	Orange-flower water	Oiss, or q. s.
	Alcohol (deodorized)	Ovj.

Mix.

Heliotrope.

Take of	Tincture of tonka	fℨxvj.
	Oil of bitter almonds	♏iij.
	Oil of rose	♏x.

Mix.

Frangipanni.

Take of	Essential oil of rose	♏xx.
	Essential oil of neroli (bigarade)	♏x.
	Essential oil of melisse	♏v.
	Essential oil of bergamot	fʒj.
	Essential oil of santal wood	fʒij.
	Extract of vanilla	fℨss.
	Extract of magnolia (from pomade)	fℨj.
	Tincture of santal wood saturated, Alcohol, āā	Cong. ss.
	Sandal water from oil	q. s. to dilute.

Mix.

Verbena Water.

Take of	Oil of balm melisse	fʒiij.
	Deodorized alcohol	Oij.
	Water	Sufficient.

Make a clear solution.

This may be made somewhat stronger, though of a less pure verbena flavor, by the addition of a little oil of lemon. Oil of balm melisse is imported; its smell seems identical with our garden lemon trifolia.

Lavender Water. (*Simple Spirit of Lavender.*)

Take of	English oil of garden lavender	fʒij.
	Deodorized alcohol	Oj.

Make a solution.

A little fresh calamus root macerated in the above improves it.

Florida Water.

Take of	Oil lavender,	
	Oil of bergamot,	
	Oil of lemon, each,	fʒij.
	Tincture of curcuma,	
	Oil of neroli, of each	fʒj.
	Oil of melisse	gtt. xxx.
	Oil of rose	gtt. x.
	Alcohol	Oij.

Mix.

Essence of Patchouly.

Take of	Oil of copaiva	gtt. xx.
	Oil of orange	gtt. iij.
	Oil of valerian	gtt. j.
	Oil of rosemary	gtt. j.
	Tincture of Tolu	gtt. xx.
	Alcohol, ginger, āā	q. s.

Mix.

Vinegars.

Camphorated Acetic Acid.

Take of	Camphor	Half ounce.
	Acetic acid	6½ fluidounces.

Pulverize the camphor by means of a few drops of spirits of wine, and dissolve it in the acetic acid. Used as a fumigative in fevers, an embrocation in rheumatism, and a refreshing and pungent perfume.

Aromatic Vinegar.

A pungent and reviving perfume, formerly esteemed a preventive of contagion.

Take of	Acetic acid, very strong,	
	Camphor, in powder,	
	Oil of cloves, of each, a sufficient quantity.	

Mix them, and secure in a strong and well-stoppered bottle.

Hygienic or Preventive Vinegar. (Piesse.)

A toilet preparation, to be mixed with water for lavatory purposes and the bath.

Take of Brandy	1 pint.
Oil of cloves	1 drachm.
Oil of lavender	1 drachm.
Oil of marjoram	½ drachm.
Gum benzoin	1 ounce.

Macerate together for a few hours, then add—

Brown vinegar	2 pints.

and strain or filter, if requisite, to be bright.

Vinaigre de Cologne.

To Eau de cologne	1 pint.
add Strong acetic acid	½ oz.

Filter if necessary.

These may be varied by substituting any other perfume, such as orange-flower or verbena water, observing, where either of these perfumed vinegars is required to produce opalescence when added to water, it should contain myrrh, benzoin, or Tolu.

Musk Perfumes.

Tincture of Musk.

Take of Musk	ʒij.
Water	Oss.

Macerate twenty-four hours, and add—

Solution of potassa, *U. S. P.*	fʒij.

Macerate twenty-four hours, and add—

Alcohol	Oss.

Let it stand at summer temperature for one month, and decant.

Extract of Musk. (Piesse.)

For mixing with other perfumes.

Take of Grain musk	2 ounces.
Rectified spirit	1 gallon.

After standing for one month at a summer temperature, it is fit to draw off.

Extrait de Musc. (Piesse.)

Adapted to retailing for use in perfumery.

Take of Extract of musk (as above)	1 pint.
Extract of ambergris	½ pint.
Extract of rose (triple)	¼ pint.

Mix and filter.

The chief uses of musk in perfumery are due to its persistent character. Though not itself desirable as a perfume, yet mixed in small proportion with rose, violet, and other essences, it enables them to give to the handkerchief a mixed odor which is retained after the first perfume is dissipated.

Tooth Preparations.

A few only of these are here given, with reference to meeting the popular demand and the ordinary requirements of the dental profession.

Marshall's or Hudson's Dentifrice.

Take of	Prepared chalk	3 pounds (com.).
	Powdered myrrh,	
	Powdered orris root, each	1 pound.
	Rose pink	1 ounce.

Thoroughly powder the ingredients and mix them through a fine sieve.

Charcoal Dentifrice.

Take of	Recently-burnt charcoal, in fine powder	6 parts.
	Powdered myrrh,	
	Powdered cinchona bark (pale), each	1 part.

Mix thoroughly.

Charcoal Tooth-paste.

Take of	Chlorate of potassa	A half drachm.
	Mint water	1 fluidounce.

Triturate to form a solution, then incorporate with—

	Powered charcoal	2 ounces.
	Honey	1 ounce.

Cuttle Fish Powder. (Piesse.)

Take of	Powdered cuttle fish	½ pound.
	Precipitated carbonate of lime	1 pound.
	Powdered orris	½ pound.
	Oil of lemons	1 ounce.
	Oil of neroli	½ drachm.

Thoroughly powder and mix.

Mialhe's Tooth Powder.

Take of	Sugar of milk	1000 parts.
	Lake	10 parts.
	Tannin	15 parts.
	Oil of mint,	
	Oil of anise,	
	Oil of neroli, of each, sufficient to flavor to taste.	

Rub well the tannin and lake together, and gradually add the sugar of milk, previously powdered and sifted, and lastly the essential oils.

A Superior Mouth Wash.

Take of	Old white Castile soap	℥ij.
	Alcohol	f℥iij.
	Honey	℥j.
	Perfume, as below	f℥iv.

Dissolve the soap in the alcohol, and add the honey and perfume.

Perfume for adding to Mouth Washes.

Take of	Asarum Canadense	℥ss.
	Orris root	℥ss.
	Strong alcohol (Atwood's)	f℥viij.

Make a tincture and add:—

Tincture of musk	f℥j.
Essence of millefleurs	f℥ss.
Essence of patchouly	gtt. xx.

Violet Mouth Wash. (Piesse.)

Take of	Tincture of orris	½ pint.
	Esprit de rose	½ pint.
	Spirit	½ pint.
	Oil of bitter almonds	5 drops.

Mix.

Botanic Styptic. (Piesse.)

Take of	Rectified spirit	1 quart.
	Rhatany,	
	Myrrh,	
	Cloves, of each	2 ounces.

Macerate 14 days and strain.

Sachet Powders and Fumigators.

The great popularity of this class of perfumes consists in their persistent odors, and their perfect adaptation in envelopes or scent-bags to diffusing an agreeable perfume in drawers, glove-boxes, etc., without soiling the purest white materials.

The following formulas, modified from those of Piesse, I have found entirely satisfactory:—

Sachet à la Frangipanni.

Take of	Orris root powder	3 pounds.
	Vetivert powder	¼ pound.
	Santal wood powder	¼ pound.
	Oil of neroli,	
	Oil of rose,	
	Oil of santal, each	1 drachm.
	Grain musk	1 drachm.

Mix well.

Sachet à la Marechale.

Take of	Powder of santal wood	½ lb.
	Powder of orris root	½ lb.
	Powder of rose leaves	¼ lb.
	Powder of cloves	2 oz.
	Powder of cassia	¼ lb.
	Grain musk	½ drachm.

Mix.

Millefleur Sachet.

Take of	Lavender flowers, ground,	
	Orris root, ground,	
	Rose leaves, ground, each	1 lb.
	Benzoin,	
	Cloves, ground,	
	Tonqua, ground,	
	Vanilla, ground,	
	Santal, ground, each	¼ lb.
	Cinnamon,	
	Allspice, each	2 ounces.
	Musk, grain	2 drachms.

Mix well together.

Heliotrope Sachet.

Take of	Powdered orris	2 lbs.
	Rose leaves, ground	1 lb.
	Tonqua beans, ground	½ lb.
	Vanilla beans, ground	¼ lb.
	Grain musk	¼ oz.
	Oil bitter almonds	5 drops.

Mix well by sifting in a coarse sieve.

Fumigating Powder.

Take of	Frankincense,	
	Benzoin,	
	Amber, of each	Three parts.
	Lavender flowers	One part.

Mix.

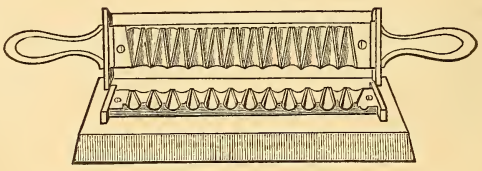
This is designed to be ignited upon coals, a stove, or hot iron, to diffuse an agreeable aroma in an apartment, and incidentally to destroy noxious effluvia.

Dr. Paris' Fumigating Pastille.

Take of	Benzoin,	
	Cascarilla, each	¼ lb.
	Myrrh	1¼ oz.
	Powdered charcoal	1½ lb.
	Oil of nutmegs,	
	Oil of cloves, each	¾ oz.
	Nitre	2 oz.

The benzoin, cascarilla, and myrrh are to be separately powdered, and mixed on a sieve with the charcoal; the nitre is then to be dissolved in mucilage of tragacanth, with which the whole is to be made into a paste and divided with a pastille mould, Fig. 244, and gradually dried.

Fig. 244.



Pastille mould.

The mode of using the pastille mould will be sufficiently obvious; the mass, rolled into cylinders of appropriate size, is pressed between the brass cutting surfaces and completely divided into twenty-four cones of the required shape.

The mode of using pastilles is to place a piece of glazed paper over a glass of water and to stand the pastille upon it when igniting it. As soon as it is sufficiently consumed it will burn a hole through the paper and be extinguished by falling into the water. Sometimes serious injury is done to mantles and articles of furniture by carelessly overlooking the intense heat produced by the combustion of these little *fumigateurs*.

Hair Preparations.

Rosemary Hair Wash.

To be used after oils have been habitually applied.

Take of Distilled water of rosemary	1 gallon.
Rectified spirit	½ pint.
Pearlash	1 ounce.

Dissolve the pearlash in the mixed alcohol and water.

Essence or Spirit of Mustard.

Take of Black mustard	2 parts.
Water	4 parts.
Alcohol	1 part.

Macerate and distil 1 part of spirit.

To be added to hair washes to supply sulphur to the hair and stimulate its growth.

Perfumed Hair Oil.

Take of Castor oil	f℥x.
Very strong alcohol	f℥ij.
Ess. of jessamine	f℥ij.

Mix.

Any other essential oil may be substituted for the essence of jessamine, and we usually label the vials according to their perfume, and color the rose oil red.

Hair Restorative.

Take of Castor oil	f℥vj.
Alcohol	f℥xxvj.

Dissolve, then add—

Tinct. of cantharides (made with strong alcohol)	f℥j.
Ess. of jessamine (or other perfume)	f℥iss.

Mix.

This preparation has the property of rendering the hair soft and glossy, at the same time that, by its tonic and stimulant properties, it tends to arrest its premature decay. To accomplish this it should be rubbed thoroughly into the roots at least once a day.

Modified Formula. (Highly esteemed by some.)

Take of Castor oil	℥iss.
Water of ammonia	f℥ij.
Tinct. of cantharides	f℥j.
Cologne	f℥iv.
Water	q. s. ft. f℥x.

Mix according to art.

Marrow Pomatum. (Piesse.)

Take of Purified lard	4 lb.
Suet	2 lb.
Oil of lemon	1 oz.
Oil of bergamot	½ oz.
Oil of cloves	3 dr.

Melt the greases, then beat them up with a whisk or wooden spatula for half an hour or more, to make the mass white and spongy; perfume with the oils.

Philicome. (Piesse.)

Take of White wax	5 oz.
Almond oil	2 lb.
Oil of bergamot	1 oz.
Oil of lemon	½ oz.
Oil of lavender	2 dr.
Oil of cloves	1 dr.

Melt the wax and oil, stir as the mixture cools, and add the perfume.

Twiggs' Hair Dye.

An excellent application to the hair, which is also a remedy for skin diseases, blemishes of the complexion, etc.

Take of Precipitated sulphur, Acetate of lead, of each	℥j.
Rose water	f℥iv.

Triturate together in a mortar. This is not an instantaneous dye, but should be applied twice a day till it gradually restores the color to its natural shade. The addition of half an ounce of glycerin will take from it a drying property which is undesirable.

Bandoline.

Take of Gum tragacanth (choice)	6 oz.
Rose water	1 gallon.
Otto of rose	½ oz.

Steep the gum in the water, agitating from time to time as it swells into a gelatinous mass; then carefully press through a coarse, clean linen cloth, and incorporate the otto of rose thoroughly through the soft mass.

PART VI.

EXTEMPORANEOUS PHARMACY.

CHAPTER I.

ON PRESCRIPTIONS.

In assigning a place in this work to prescriptions, and to the art of prescribing medicines, it is with a full appreciation of its intimate connection with therapeutics, a branch of knowledge with which, as a pharmacist, I lay claim to but little practical acquaintance; and yet this subject has bearings which are peculiarly adapted to arrest the attention of one whose daily avocations place him directly between the physician and the patient, and give him favorable opportunities for judging of the pharmaceutical eligibility of combinations, and not unfrequently of their effects.

The art of prescribing medicines has so intimate a connection with that of preparing and dispensing them, that a treatise on the latter subject, not embracing the former, would be wanting in its most interesting feature to the student of medicine and the physician. In a work like the present, it seems appropriate to approach the art of dispensing through a brief general treatise on that of prescribing.

It is a common remark of recent graduates of medicine, that one of their greatest difficulties is in writing prescriptions; lacking the means of systematic instruction in this most important practical duty, they are apt to fall into confused and unscientific methods of prescribing, from which no amount of experience entirely rids them.

The art of prescribing is the practical application of the knowledge of therapeutics, chemistry, and pharmacy, to the cure of disease. No department of his duties puts the skill of the physician to a closer test; none calls for the exercise, to a greater extent, of that invaluable quality, whether intuitive or acquired, called *tact;* and yet few departments of medical knowledge are less insisted upon as necessary branches of a medical education.

Although the art of prescribing can only be acquired practically, the general principles pertaining to it are capable of classification, and have been fully discussed.

The celebrated *Pharmacologia* of Dr. Paris, of London, published originally in 1812, contains the fullest dissertation in our language

upon "the science and art of prescribing." Many of the views taught at that time, however, are now abandoned, and the subject is capable of being simplified in accordance with modern improvements in pharmacy. The large number of efficient and permanent Galenical preparations makes prescribing comparatively easy to the practitioner who has kept pace with the advance of the times, while the publication of *Formularies*, in which a variety of preparations of each drug are detailed, has to a certain extent superseded an original and extemporaneous system of selection and combination of remedies.

Medicinal preparations which are kept on hand by the apothecary, to be dispensed alone or used in compounding prescriptions, are called *permanent*, while those compounded by direction of the practitioner to meet the indications as they arise in practice, are called *extemporneaous.*

This distinction, however, is far from being well marked. Some of those called permanent are known to deteriorate in a greater or less degree by age, while many classed as extemporaneous will keep an indefinite length of time. For most of the permanent class we have recipes, or prescriptions, published in *Pharmacopœias*, *Dispensatories*, or *Medical Formularies*, while the extemporaneous are usually the product of the skill and ingenuity of the prescriber at the bedside of his patient. Objections lie against the use of established prescriptions to the exclusion of those dictated by the emergencies of the case, from the impracticability of adapting any set of formulas to every shade of disease and of idiosyncrasy, and from the impossibility of the practitioner storing in his memory their ingredients, proportions, etc.; so that the thorough student does well to acquire a knowledge of the *principles*, to regulate the selection and combination of remedies, and to learn the art of prescribing *experimentally.*

A limited number of prescriptions, framed with a view of illustrating these principles and modes of combination, will, with this object in view, be highly useful to the student; but these must be regarded as stepping-stones to a knowledge of the art of prescribing rather than as embodying that knowledge. The vast extent and variety of adaptation of the Materia Medica preclude the possibility of compressing into any series of prescriptions, a complete view of all the modifications attainable on enlightened therapeutical and pharmaceutical principles.

Under the head of Galenical preparations, a prominent distinction has been drawn between those which are officinal in the *U. S.* and *British Pharmacopœias* and those which are not; the use of Italics for the unofficinal, calling attention to their comparatively unimportant position, has been a conspicuous feature in the syllabi intended for the use of the student in committing to memory their names, proportions, properties, and doses. In the part of the work which follows, this distinction is regarded as less important, and most of the formulæ are introduced less with a view to impress

them upon the memory, than to illustrate the pharmaceutical principles on which they are based.

The very obvious division of preparations into simple and compound needs no other mention than to explain that the addition of a vehicle or menstruum, not added with a view to its medical effect, does not render a preparation compound, in the sense in which that term is ordinarily applied. *Simple* rhubarb pills contain rhubarb and soap; while *compound* rhubarb pills contain rhubarb, aloes, myrrh, and oil of peppermint; and with a view to furnish distinctions between preparations which have very similar composition, the term *compound* is sometimes useful.

The Language used in Prescriptions.

In Great Britain and the North of Europe, prescriptions are written in Latin; in France, in the vernacular language. We mostly follow the British custom, although some of our practitioners depart from the usual style, and follow the *Pharmacopœia* by inditing their prescriptions in plain English. The relative adaptation of Latin and English for the purpose has long been discussed, and is still a mooted point among physicians and pharmacists. It is unnecessary to dwell upon the arguments advanced on either side, and which seem naturally to suggest themselves. The chief desideratum is to secure accuracy without an unnecessary and cumbersome phraseology, and for this purpose the *officinal names* of all medicines are to be preferred to either of their common and changing synonyms.

Many medicines are called by very different names in different parts of the country, and the same name is liable to be applied to either of several different drugs. If *snakeroot* were ordered, the pharmacist might be at a loss whether serpentaria, cimicifuga, asarum, senega, eryngium, or some of the numerous other roots occasionally, or perhaps locally, denominated snakeroots, were desired; while, if the specific English name, as *Virginia*, *Canada*, *black* or *button* snakeroots, was applied, the merit of conciseness would be sacrificed.

If chamomile were ordered, it would be necessary to specify whether Roman, German, or American; while in Latin, anthemis, matricaria, or maruta would be both short and distinctive.

In the foregoing illustrations, however, we have the least forcible instances. There can be no comparison in eligibility between the names sugar of lead and Plumbi acetas, white vitriol and Zinci sulphas, liver of sulphur and Potassii sulphuretum, salt of tartar and Potassii carbonas. The name which expresses the chemical composition of a substance is generally, of all that can be devised, the best; and hence, even in common language, many familiar chemical substances are beginning to be called by their chemical names. Although there is little difference between the English and the Latin chemical names, the latter has the advantage for use in prescription: it is easier of abbreviation, or its abbreviations are more

familiar; while the omission of the connecting preposition *of*, between the two parts of the name, reduces it to a single compound word, rendering it shorter and more quickly written.

It is often urged that the Latin used in prescription is, for the most part, quite incorrect, especially when the terminations are attempted; but grammatical errors are certainly far less important than either chemical, pharmaceutical, or therapeutical; and when we consider how few physicians, even among those classically educated, have advantages for keeping up, throughout the busy scenes of their professional career, the knowledge of Latin acquired in their schoolboy days, we can scarcely wonder that many errors of this description occur. Moreover, the language used in prescription, viewed with reference to its abbreviations, signs, and Latinized names of various origin, must be regarded as distinct from the Latin taught in schools, and requires to be studied in connection with scientific nomenclature generally, and, in fact, constitutes a part of the study of Materia Medica and Pharmacy. Every officinal drug and preparation has its particular name given to it authoritatively in the *Pharmacopœia*, and those not there mentioned may be distinguished by their appropriate botanical or chemical designations. The groundwork of the correct writing of prescriptions is a knowledge of these names; and it matters little whether the physician writes his prescriptions in Latin or English, if he designates each individual article by its *officinal name*.

The propriety of using the officinal Latinized names in a plain English formula may admit of a doubt, but, if sanctioned by custom and authority, might be adopted, and thus the principal objection to the English prescription would be removed. The officinal name, though framed upon a Latin model, might be separated from the idea of its origin, and used in the prescription as a distinctive pharmaceutical term, following the genius of the language in which it is used: in a Latin prescription, its terminations would be varied as the construction of that language requires; and in an English prescription, might follow the rules for the construction of a correct English sentence. We have very many officinal names that are as commonly incorporated into our language as the English synonyms attached to them, and the objections to considering all the names in the American and British *Pharmacopœias* as English words are, it appears to me, not such as to overrule a custom which, on so many accounts, is to be desired.

The officinal names are spoken of in detail in the chapter on the *Pharmacopœia*, and the importance of a study of them has been elsewhere referred to; and I repeat, if these were properly mastered by the student, and invariably used to designate the drugs and preparations to which they belong, the framework in which the prescription is inclosed would be, comparatively, of little importance.

There are some cases in which the use of an explanatory synonym in parentheses seems quite necessary, whether the name be Latinized or not; and in such cases it should never be omitted for the sake of elegance or attempted correctness of diction. In prescribing the

finer kinds of magnesia, there is no other resource than to say in parentheses (Henry's), (Husband's), or (Ellis'), as the case may be. Liquor aloes. comp. would be quite indefinite without (Mettauer) appended, and tinct. guaiaci comp. would be misunderstood unless accompanied by the added (Dewees') to explain it.

The remarks before made apply to the *names* of substances designated in prescriptions; the other parts of the prescription, which will be referred to more particularly in the sequel, consist chiefiy of abbreviations and signs which custom has long sanctioned, and which are considered to pertain particularly to the *Latin* prescription, though, as before stated, occasionally, and without any breach of propriety, used in connection with the English.

In the prescriptions appended to the several chapters which follow, numerous examples are given of both Latin and English prescriptions, and they will be appropriately preceded by the following, taken from Dr. Pereira's "*Selecta e Prescriptis.*"

Grammatical Explanation of a Prescription.

(1) ℞.—Ferri carbonatis, drachmam cum semissse (℥jss).
(2) Rhei pulveris, grana quindecim (gr. xv).
(3) Olei anthemidis, guttas quinque (gtt. v).
(4) Conservæ rosæ, quantum sufficiat ut fiat massula in pilulas viginti dividenda, quarum sumat æger tres octavis horis.

(1) RECIPE, verb active, imp. mood, 2d pers. sing. agreeing with *Tu*, understood; from *Recipio, ĕre, cepi, ceptum*, 3d conj. act. Governs an accusative,
DRACHMAM, noun, subst. acc. sing. from *Drachma, æ*, f. 1st decl. Governed by *Recipe.*
CUM, preposition. Governing an ablative case.
SEMISSE, subst. abl. case, from *Semissis, is*, f. 3d decl. Governed by *cum.*
CARBONATIS, subst. gen. sing. from *Carbonas, atis*, f. 3d decl. Governed by *Drachmam.*
FERRI, subst. gen. sing. from *Ferrum, i*, n. 2d decl. Governed by *Carbonatis.*
(2) RECIPE, understood.
GRANA, subst. acc. pl. from *Granum, i*, n. 2d decl. Governed by *Recipe*, understood.
QUINDECIM, adj. indeclin.
PULVERIS, subst., gen. sing. from *Pulvis, eris*, m. 3d decl. Governed by *Grana.*
RHEI, subst. gen. sing. from *Rheum, i*, n. 2d decl. Governed by *Pulveris.*
(3) RECIPE, understood.
GUTTAS, subst. acc. pl. from *Gutta, æ*, f. 1st decl. Governed by *Recipe*, understood.
QUINQUE, adj. indeclin.
OLEI, subst., gen. sing. from *Oleum, ei*, n. 2d declen. Governed by *Guttas.*
ANTHEMIDIS, subst. gen. sing. from *Anthemis, idis*, f. 3d decl. Governed by *Olei.*
(4) RECIPE, understood.
QUANTUM, adverb. Governing the genitive case.
SUFFICIAT, verb impers. potent. mood, pres. tense, from *Sufficio, ĕre, feci, fectum*, neut. and act. 3d conj.
CONSERVÆ, subst. gen. sing. from *Conserva, æ*, f. 1st. decl. Governed by *Quantum.*
ROSÆ, subst. gen. sing. from *Rosa, æ*, f. 1st. decl. Governed by *Conservæ.*
UT, conjunct. Governing a subjunct. mood.
MASSULA, subst. nom. case *a, æ*, f. 1st decl.
FIAT, verb. subj. mood, pres. tense, 3d person singular, from *Fio, fis, factus sum* vel *fui, fieri*, neut. Governed by *Ut*, and agreeing with the nominative case *Massula.*
DIVIDENDA, particip. nom. case, fem. gend. from *Dividendus, a, um* (à *dividor, i, sus*, pass. 3d conj.). Agreeing with *Massula.*
IN, preposition. Governing an accusative case.
PILULAS, subst. acc. pl. from *Pilula, æ*, f. 1st. decl. Governed by *In.*
VIGINTI, adj. indecl.
QUARUM, relative pronoun, gen. pl. fem. from *Qui, quæ, quod.* Agreeing with its antecedent *Pilulas* in gender and number. Governed in the gen. case by *Tres.*
ÆGER, adj. mas. gend. nom. *Æger, ægra, ægrum.* Agreeing with *homo*, understood.

Sumat, verb, 3d pers. sing. imp. mood, from *Sumo, ere, psi, ptum*, act. 3d conj. Agreeing with *homo*, understood; governing an acc. case.

Tres, ad. acc. pl. fem. from *Tres, tres, tria.* Agreeing with *Pilulas*, understood, and which is governed by *Sumat.*

Horis, subs. abl. plural, from *Hora, æ*, f. 1st decl.; signifying part of time, and therefore put in the abl. case.

Octavis, adj., abl. plur. fem. from *Octavus, a, um.* Agreeing with *horis.*

Abbreviations.—Mistakes not unfrequently arise from unskilful abbreviations, for, while there can be no objection to shortening many of the long names given to medicines, there is certainly great danger from the inordinate and unskilful exercise of this privilege; the word *cal.* is an occasional and very poor abbreviation for hydrargyri chloridum mite. Through a careless termination of familiar words, serious accidents are liable to occur. Several years have elapsed since I received a prescription for *hydrate potassæ* ʒj, to be dissolved in water fʒiij (dose, a teaspoonful), and it was only through a care which has become habitual that I saved a delicate lady in that case from taking large doses of hydrate of (caustic) potassa instead of hydriodate of potassa. There were no directions for use appended, so that I had not the advantage they give in cases of doubt. The abbreviations allowable in prescriptions might fill some pages if tabulated, but to the physician for his own use, no practical advantage would result from it, while the habit once acquired, of *writing every word so fully that it could be mistaken for no other*, would quite obviate the evils complained of, yet for the pharmacist's sake most of them will be given.

Symbols or Signs used in Prescriptions.

m. Minim, $\frac{1}{60}$ part of a fluidrachm.
gtt. Gutta, a drop; guttæ, drops.
℈j. Scrupulus vel scrupulum, a scruple = 20 grains.
ʒj. drachma, a drachm = 60 grains.
fʒj. fluidrachma, a fluid or measured drachm.
℥j. Uncia, a troyounce = 480 grains.
f℥j. Fluiduncia, a fluidounce.
℔j. Libra, a pound, understood in prescriptions to apply to an officinal pound of 5760 grains.
Oj. Octarius, a pint.
gr. Granum, a grain; plural grana, grains.
ss. Semis, half, affixed to signs as above.

The Latin numerals are employed in prescription—i, ij, iij, iv, v, vi, vij, viij, ix, x, xi, xij, xv, xx, XL, L, C, etc.; and in the directions, when written in Latin, a variety of antiquated terms, explained in Dr. Pereira's little work before mentioned, but requiring too much space for insertion here.

Before leaving the subject of the signs employed in prescriptions, it seems proper to advert to the errors which frequently occur from their careless use, and which have led some practitioners to advocate their entire abandonment. They are, however, too well established in the actual practice of this country and England, and too convenient, to be readily supplanted. The angle and curve ʒ

may be made so carelessly as to resemble the ℈ with a flourish at top, and ℥j may look like a ʒj, or may be so completely perverted from its recognized shape as to leave the reader in doubt whether a ℈ or ℥ is intended. Notwithstanding the apparent absurdity of this, there are not a few prescriptions on our files in which the sign intended has been reached only by guessing, or by reasoning upon the known dose of the drug, rather than upon the shape of the sign. *A flourishing style of chirography is nowhere less in place than on a physician's prescription.* The numerals are equally liable to error if carelessly made, the difference between j and v, and between iv and iij, and between x and v, is often quite obscured by a neglect of the plain and necessary precautions of accuracy and care. It is not easy to illustrate in print what an examination of the chirography of many prescriptions would make apparent, that the *reading* of a prescription frequently requires more skill and judgment than *compounding* it.

Method of Writing Prescriptions.

The first care to observe in writing a prescription is to have suitable paper and pencil, or preferably, pen and ink. The habit of some of using the margin of a newspaper, the fly-leaf of a schoolbook, or any piece of flimsy material at hand, for inditing a prescription, upon which may depend the life of the patient, cannot be too strongly condemned. It indicates a want of care in the physician, which, if carried into other duties, would quite unfit him for the responsibilities of his profession. Many physicians adopt the plan of cutting, from time to time, suitable fragments of good paper, which are carried in a pocket-book or wallet, and are always at hand on emergencies. With a view to economy, the fly-leaves of letters and notices, which would be otherwise wasted, may be pressed out, and appropriated to this object. Some pharmacists are in the habit of printing their cards at the head of suitable prescription sheets, and distributing them among physicians with a view to attracting business to their shops; a practice more honored in the breach than in the observance. Some physicians provide prescription papers, with their name and address attached, which is not without one advantage—it enables the pharmacist always to trace the prescription readily to its source in case of difficulty.

Having the proper prescription paper, the next step is to write at the top the name of the patient; this precaution, which is very often neglected, is important for several reasons: 1st. It enables the nurse or attendant to distinguish, by a certain and ready means, between prescriptions designed for different patients; and the name being transferred to the label, there is no excuse for a similar mistake in "administering." 2d. It enables the apothecary, in every case, to avoid the mistake so often made in the hurry of business, of dispensing a package of medicine to one of several customers in waiting, which should have been given to another. 3d. It facilitates the recognition of the prescription upon the apothe-

cary's file when its renewal is called for; and, finally, it evinces a care which is commendable on so important an occasion as prescribing for the sick.

The practice of heading a prescription with the generic name of the class of medicines to which it belongs, should be observed when there are two or more in use; as the *Gargle*, the *Liniment*, or the *Fever Mixture*. Frequently, however, this is superseded by giving its designation in the *Subscription*, accompanied by directions for its use. As a general rule, I would say that all topical remedies should be distinctly marked *For external use*. Some mistakes have originated from neglect of this precaution which would be most ludicrous if the subject was not often too serious for merriment: for instance, the administration of ammoniated liniment, in tablespoonful doses, while a cinchona bark mixture is applied over the seat of rheumatic pain.

It is well, in some cases, to copy on the label the entire prescription. A physician in large practice, unless he has a very retentive memory, will forget the details of his prescription of the previous day; this precaution is important in prescribing for patients travelling from home. It is often prudent for the physician to direct the apothecary to mark the medicine prescribed *Poison*, or, as is sometimes done, "*Use with care;*" giving, at the same time, the particular instructions for its use.

The prescription may be divided, for the purpose of study, into the following parts, each of which will be separately considered: 1. The superscription. 2. The inscription. 3. The subscription. 4. The signatura.

The *Superscription* consists of a very short abbreviation of the Latin verb *Recipe*, imperative mood of *Recipio*, I take, viz.: the letter ℞, which is often printed near the top of the prescription sheet. In French, the letter *P* is used for *Prenez*. In English formulas, the ℞ should be substituted by *Take of*.

The *Inscription* is the indication, seriatim, of the names and quantities of the remedies prescribed. The order in which these are written is not a matter of much real importance, as a competent pharmacist will, in mixing them, depart from the sequence observed in the prescription, if thought best; while the physician will find it more convenient to follow the order of their therapeutical importance rather than the rotation in which they should be added to the mixture.

In the sequel I shall refer to the therapeutical classification of ingredients, which, in a well-contrived prescription, would be written in the following order: 1. The basis. 2. The adjuvant. 3. The corrective. 4. The excipient. 5. The diluent.

This is not only the most elegant, but the most natural rotation to be observed.

One of the greatest difficulties to the beginner, in connection with this subject, is in determining, as the prescription proceeds, the appropriate quantity of each ingredient, so as to have each in

due proportion, and with its right dose; this becomes easy by the employment of the following

Rule for Apportioning Quantities.—Write down the names of the several ingredients first, without regard to quantity; then having determined upon the quantity of the whole preparation, and the dose to be prescribed, the whole number of doses will be readily calculated, and the *quantity* of each ingredient may be affixed.

As doses are, at best, only approximate, we may depart from the precise figures obtained by dividing the whole number of drachms, grains, etc., in the preparation, by the number of doses it will contain, as far as necessary to get even numbers, or convenient fractions of a drachm and ounce.

In directing pills, or powders, we have the means of attaining considerable accuracy, and may readily direct a combination of ingredients to be divided into ten, twenty, or thirty parts, from the very convenient relations of these numbers to the drachm and scruple weights; but it will be found more convenient in dispensing and administering the preparations, to have six, or twelve, or twenty-four parts ordered, as these numbers have relation to the number of grooves in the pill machine, and to the number of hours in a day.

The Table below will assist the beginner in prescribing liquids, and will serve for reference until he becomes accustomed, practically, to this rather difficult part of his duties. Having fixed upon the bulk of his mixture or solution, he will remember that there are *about*

8 wineglassfuls	(each f℥ij)	in a pint (f℥xvj).
30 tablespoonfuls	(" f℥ss)	in a pint (f℥xvj).
15 tablespoonfuls	(" f℥ss)	in half a pint (f℥viij).
12 tablespoonfuls	(" f℥ss)	in 6 fluidounces (f℥vj).
20 dessertspoonfuls	(" f℥ij)	in 6 fluidounces (f℥vj).
15 dessertspoonfuls	(" f℥ij)	in 4 fluidounces (f℥iv).
30 teaspoonfuls	(" f℥j)	in 4 fluidounces (f℥iv).
15 teaspoonfuls	(" f℥j)	in 2 fluidounces (f℥ij).
8 teaspoonfuls	(" f℥j)	in 1 fluidounce (f℥j).

We have an illustration of this method of division in the officinal liquor morphiæ sulphatis, in which one grain of the salt is dissolved in one fluidounce of water; as there are about eight teaspoofuls in an ounce, one teaspoonful represents about one-eighth grain, which is the dose.

In the case of liquids to be given by drops, care must be taken to distinguish between aqueous, alcoholic, and oily liquids. By reference to the table given in the chapter on Weights and Measures, the relative size of drops pertaining to different liquids will appear; in this connection it will be only necessary to refer to that table, and to apply the same general mode of calculation to the apportionment of doses of these.

One cause of fallacy, with the student, in prescribing by drops, arises from confounding the size of drops of one ingredient of a pre-

paration with the size of drops of the preparation after it is made. Thus, if a fluidrachm of tincture of veratrum viride were added to seven fluidrachms of an aqueous solution of morphia, or tartar emetic, we should calculate about sixty drops to each fluidrachm, not one hundred and twenty, which would be proper were the alcoholic liquid in much the larger proportion.

The *subscription* has reference to the manner of mixing and dividing the medicine. In Latin prescriptions, it usually consists of short abbreviations, or signs, which are familiar to pharmacists, though in some cases it is written out in full in Latin, and in others in plain English. The verb *Misce* (imperative mood of misceo, I mix), or the letter *M.*, designed to represent it, constitutes the most common subscription. Sometimes, where especial skill or care is required in the preparation, *secundem artem*, or *S. A.*, is affixed to it; when omitted, however, this is understood. The verb *Solve* (imperative of solvo, I dissolve) is more appropriate where a simple solution is prescribed; or *Macera* (imperative of macero), where the process of maceration is directed; where filtration is necessary, write thereafter *et cola.* When a medicine is directed in very fine powder, the practitioner may make choice of *Tere bene* (triturate well), or *Fiat pulvis subtilissimus* (make a very fine powder). It is, perhaps, an improvement on the above to direct more specifically the sort of preparation designed; it gives the pharmacist a clue which is sometimes useful to him in compounding, as well as in correcting gross errors. The following terms, with their proper abbreviations and translations, may serve to guide the student in writing his *Subscription.* They include the appropriate directions for dividing medicines into powders, pills, lozenges, etc., and will appropriately close the notice of this part of the prescription.

Fiat pulvis, Ft. pulv. Make a powder.
Fiant pulveres xij; Ft. pulv. xij.
Fiat pulvis et divide in chartulas xij; Ft. pulv. et divid. in chart. xij.
Fiat pulvis in chartulas xij dividenda; Ft. pulv. in ch. xij div.
Fiant chartulæ xij; Ft. chart. xij.
} Make twelve powders.
Fiat solutio, Ft. solut. Make a solution.
Fiat injectio, Ft. inject. Make an injection (for urethra).
Fiat collyrium, Ft. collyr. Make an eye-wash.
Fiat enema, Ft. enema. Make an injection (for rectum).
Fiat suppositorium, Ft. supposit. Make a suppository.
Fiant suppositoria iv; Ft. suppos. iv. Make 4 suppositories.
Fiat massa, Ft. massa. Make a mass.
Fiant pilulæ xij; Ft. pil. xij.
Fiat massa in pilulas xij dividenda; Ft. mas. in pil. xij div.
Fiat massa et divide in pilulas xij; Ft. mas. div. in pil. xij.
} Make twelve pills.
Fiat infusum, F. infus. Make an infusion.
Fiat haustus, Ft. haust. Make a draught.
Fiat gargarisma, Ft. garg. Make a gargle.
Fiat mistura, Ft. mist. Make a mixture.
Fiat emulsio, Ft. emuls. Make an emulsion.
Fiat electuarium, Ft. elect. Make an electuary.
Fiat confectio, Ft. confect. Make a confection.
Fiat emplastrum, 6 x 4; Ft. emp. 6 x 4. Make a plaster 6 by 4 inches.
Fiat emp. epispasticum, Ft. emp. epispast.
Fiat emp. vesicatorium, Ft. emp. vesicat.
} Make a blister.
Fiat unguentum, Ft. ung. Make an ointment.
Fiat ceratum, Ft. cerat. Make a cerate.

Fiat cataplasma, Ft. cataplasm. Make a poultice.
Fiat linimentum, Ft. linim. Make a liniment.
Fiat trochisci xxiv; Ft. troch. xxiv. Make 24 lozenges.
Fiat massa in trochiscos xl dividenda; Ft. mas. in troch. xl. div. Make 40 lozenges.

The habit of writing the signatura or directions for taking the medicine prescribed in Latin has become so nearly obsolete that large numbers of quite skilful apothecaries would be at a loss to append the directions thus given, to a prescription; especially so is this the case since many of the more recently published treatises on pharmacy have omitted the lists of terms generally used and their abbreviations. With the design of supplying this want, the following list is compiled and made as full as is thought necessary to serve the purposes of the pharmacist.

A, āā, ana. Of each.
Abdom., abdomen. The belly.
Abs. febr., absente febre. Fever being absent.
Ad 2 vic., ad secundem vicem. To the second time.
Ad. or add., adde or addantur. Add, or let them be added.
Ad def. an., ad defectionem animi. To fainting.
Ad del. an., ad deliquium animi. To fainting.
Ad grat. acid., ad gratam aciditatem. To an agreeable acidity.
Ad lib., ad libitum. At pleasure.
Adjac., adjacens. Adjacent.
Admov., admove, admoveatur, admoveantur. Apply, let it be applied, let them be applied.
Ads. febr., adstante febre. While the fever is present.
Alter. hora, alternis horis. Every other hour.
Alv. adst., alvo adstrictâ. The bowels being confined.
Aq. astr., aqua astricta. Frozen water.
Aq. bull., aqua bulliens. Boiling water.
Aq. comm., aqua communis. Common water.
Aq. ferv., aqua fervens. Hot water.
Aq. fluv., aqua fluviatilis. River water.
Aq. font., aqua fontis. Spring water.
Aq. mar., aqua marina. Sea water.
Aq. niv., aqua nivalis. Snow water.
Aq. pluv., aqua pluviatilis or pluvialis. Rain water.
B A., balneum arenæ. Sand-bath.
Bals., balsamum. Balsam.
B.B., B.B.S., Barbadensis. Barbadoes.
Bib., bibe. Drink.
Bis in d., bis in die. Twice a day.
B. M., balneum maris. A salt-water bath.
Bol. Bolus.
Bull., bulliat. Let it boil.
But., butyrum. Butter.
B. V., balneum vaporis. A vapor-bath.
Cærul., cæruleus. Blue.
Calom., calomel. Mild chloride of mercury.
Cap., capiat. Let him (or her) take.
C. C., cornu cervi. Hartshorn.
C. C. U., cornu cervi ustum. Burnt hartshorn.
C. M., cras mane. To-morrow morning.
C. N., cras nocte. To-morrow night.
C. V., cras vespere. To-morrow evening.
Chart., charta, chartula. Paper, or small paper.
Cochleat., cochleatim. By spoonfuls.
Coch. ampl., cochleare amplum. A large (or table-) spoonful, about half a fluidounce.
Coch. infant., cochleare infantis. A child's spoonful.
Coch. magn., cochleare magnum. A large spoonful.

Coch. med. } A medium or moderate spoonful, a dessertspoonful, about two flui-
Coch. mod. } drachms.
Coch. parv., cochleare parvum. A small (or tea-) spoonful, about one fluidrachm.
Col., cola, colatur. Strain, let it be strained.
Colat., colaturæ. To the strained liquor.
Color., coloretur. Let it be colored.
Collyr., collyrium. An eye-wash.
Comp., compositus. Compounded.
Conf., confectio. Confection.
Cong., congius. A gallon.
Cons, conserva. A conserve; may mean, keep.
Cont., continuetur. Let it be continued.
Coq., coque, coquantur. Boil, let them be boiled.
Coq. ad med. consump., coque or coquatur ad medietatis consumptionem. Boil, or let it be boiled, to the consumption of one-half.
Coq. S. A., coque secundem artem. Boil according to art.
Coq. in S. A., coque in sufficiente quantitate aquæ. Boil in a sufficient quantity of water.
Cort., cortex. Bark.
Cras., crastinus. For to-morrow.
Cuj., cujus. Of which.
Cujusl., cujuslibet. Of any.
Cyath. the., cyatho theæ. In a cup of tea.
Cyath., cyathus. } A wineglass, about an ounce and a half to two fluid-
C. vinar., cyathus vinarius. } ounces.
D., dosis. A dose.
D. et S. Detur et signetur.
D. D., detur ad. Let it be given in or to.
D. D. vit., detur ad vitrum. Let it be given in a glass.
Deaur. pil., deaurentur pilulæ. Let the pills be gilded.
Deb. spiss., debita spissitudo. A due consistence.
Dec., decanta. Pour off.
Decub. hor., decubitûs horâ. At the hour of going to bed.
De d. in d., de die in diem. From day to day.
Deglut., deglutiatur. Let it be swallowed.
Dej. alv., dejectiones alvi. Stools.
Det., detur. Let it be given.
Dieb. alt., diebus alternis. Every other day.
Dieb. ter., diebus tertiis. Every third day.
Dig., digeratur. Let it be digested.
Dil., dilue, dilutus. Dilute, diluted.
Diluc. diluculo. At day-break.
Dim., dimidius. One-half.
Dist., distilla. Distil.
Div., divide. Divide.
D. in 2 plo, detur in tuplo. Let it be given in twice the quantity.
D. in p. æq., dividatur in partes æquales. Let it be divided in equal parts.
D. P., directione propria. With a proper direction.
Donec alv. bis dej., donec alvus bis dejecerit. Until the bowels have been twice opened.
Donec dol. neph. exulav., donec dolor nephriticus exulaverit. Until the nephritic pain has been removed.
Drachm, drachma. A drachm.
Eburn., eberneus. Made of ivory.
Ed., edulcorata. Edulcorated.
Ejusd., ejusdem. Of the same.
Elect., electuarium. Electuary.
Enem., enema. A clyster.
Exhib., exhiberatur. Let it be administered.
Ext. super alut. moll., extende super alutam mollem. Spread upon soft leather.
F., fac. Make.
Ft., fiat, fiant. Let it be made, let them be made.
F. pil., fiant pilulæ. Let pills be made.
Fasc., fasciculus. A bundle.
Feb. dur., febre durante. During the fever.
Fem. intern., femoribus internis. To the inside of the thighs.
Fict., fictilis. Earthen.

F. H., fiat haustus. Let a draught be made.
F. venæs, fiat venæsectio. Let bleeding be performed.
Fil., filtrum. A filter.
Fist. arm., fistula armata. A clyster-pipe and bladder ready for use.
Fl., fluidus. Fluid.
F. L. A., fiat lege artis. Let it be made by the rules of art.
F. M., fiat mistura. Let a mixture be made.
F. S. A., fiat secundem artem. Let it be made according to art.
Flor., flores. Flowers.
Frust., frustillatim. In small pieces.
Garg., gargarysma. A gargle.
Gel. quav., gelatinâ quavis. In any jelly.
G. G. G., gummi gutta gambæ. Gamboge.
Gr., granum. A grain.
Gr. vi pond., grana sex pondere. Six grains by weight.
Gtt., gutta, guttæ. A drop, drops.
Gtt. quibusd., guttis quibusdem. With some drops.
Gum., gummi. Gum.
Guttat., guttatim. By drops.
Har. pil. sum. iij, harum pilularum sumantur tres. Of these pills let three be taken.
Haus., haustus. A draught.
Hor. dec., horâ decubitus. At bedtime.
H. S., horâ somni. At the hour of going to sleep.
Hor. interm., horâ intermediis. In the intermediate hours.
Hor. un. spatio, horæ unus spatio. At the expiration of one hour.
Hor. 11mâ mat., horâ undecimâ matutinâ. At eleven o'clock in the morning.
In d., in dies. Daily.
Inf., infund. Infuse.
Inj. enem., injiceatur enema. Let a clyster be injected.
In pulm., in pulmento. In gruel.
Jul., julepus, julapium. A julep.
Kal. ppt., kali præparatum (potassii carbonas).
Lat. dol., lateri dolenti. To the affected side.
Lb., lib., libra. A pound; llb., libræ, pounds.
Liq. Liquor.
M., misce. Mix.
Mane pr., mane primo. Early in the morning.
Manipulus. A handful.
Mensura. By measure.
Minimum. A minim; $\frac{1}{60}$th part of a fluidrachm.
M. P., massa pilularum. A pill mass.
Mass., massa. A mass.
M.R., mistura. A mixture.
Mic. pan., mica panis. Crumb of bread.
Mitt., mitte send. mittantur. Let them be sent.
Mitt. sang. ad f℥xij, mitte sanguinem ad f℥xij. Take blood to twelve fluidounces.
Mod. præscr., modo præscripto. In the manner prescribed.
Mor. dic., more dicto. In the way ordered.
Mor. sol., more solito. In the usual way.
Muc., mucilago. Mucilage.
N. M., nux moschata. A nutmeg.
Ne tr. s. num., ne tradas sine nummo. Do not deliver it without the money.
No., numero. In number.
O., octarius. A pint.
Ol. lini s. i., oleum lini sine igne. Cold-pressed linseed oil.
Omn. hor., omni horâ. Every hour.
Omn. bid., omni biduo. Every two days.
Omn. bih., omni bihorio. Every two hours.
O. M., or omn. man., omni mane. Every morning.
O. N., or omn. noct., omne nocte. Every night.
Omn. quad. hor., omni quadrante horâ. Every quarter of an hour.
O. O. O., oleum olivæ optimum. Best olive oil.
Ov., ovum. An egg.
Ox. Oxymel.
Oz. The avoirdupois ounce, in contradistinction to that prescribed by physicians.

P., pondere. By weight.
P. æ., part. æqual., partes æquales. Equal parts.
P. d., per deliquium. By deliquescence.
Past., pastillus. A pastil, or a ball of paste.
Part. vic., partitis vicibus. In divided doses.
Per op. emet., per actâ operatione emetici. The operation of the emetic being over.
Ph. Br. Pharmacopœia Britannica.
Ph. D. Pharmacopœia Dublinensis.
Ph. E. Pharmacopœia Edinensis.
Ph. L. Pharmacopœia Londinensis.
Ph. U. S. Pharmacopœia of the United States.
Pil., pilula, pilulæ. Pill or pills.
Pocul., poculum. A cup.
Pocill., pocillum. A small cup.
Post sing. sed. liq., post singulas sedes liquidas. After every loose stool.
Pot., potio. A potion; a liquid medicine from four to eight ounces in quantity.
Ppt., præparatus. Prepared.
P. r. n., pro re natâ. Occasionally.
P. rat. ætat., pro ratione ætatis. According to the age.
Pug., pugillus. A pinch; a gripe between the thumb and two first fingers.
Pulv , pulveris, pulverizatus. A powder; pulverized.
Q. L., quantum libet. } As much as you please.
Q. P., quantum placet. }
Q. S., quantum sufficiat. As much as may suffice.
Quar., quarum. } Of which.
Quor., quorum. }
Quantum vis. As much as you will.
Rad., radix. A root.
Ras., rasuræ. Shavings.
Red. in pulv., redactus in pulverem. Reduced to powder.
Redig. in pulv., redigatur in pulverem. Let it be reduced into powder.
Reg. umbilici. The umbilical region.
Repet., repetatur or repetantur. Let it or them be repeated.
S , signa. Write.
S A., secundum artem. According to art.
Scat., scatula. A box.
Sem., semen. A seed.
Semidr., semidrachma. Half a drachm.
Semih., semihora. Half an hour.
Sesunc., sesuncia. Half an ounce.
Sesquih., sesquihora. An hour and a half.
Si n. val., si non valeat. If it does not answer.
Si op. sit, si opus sit. If it be necessary.
Si ver. perm., si vires permittant. If the strength allow it.
Signat., signatura. A label.
Sign. n. pr., signetur nomine proprio. Let it be written upon; let it be signed with the proper name (not the trade name).
Sing., singulorum. Of each.
Solv., solve. Dissolve.
S. S. S., stratum super stratum. Layer upon layer.
Ss., semis. A half.
St , stet, stent. Let it stand, let them stand.
Sub fin. coct., sub finem coctionis. Towards the end of the boiling; when the boiling is nearly finished.
Sum. tal., sumat talem. Let him take such a one as this.
Summ., summitates. The summits or tops.
Sum., sume, sumat, sumatur, sumantur. Take, let him or her take, let it be taken, let them be taken.
S. V., Spiritus vini. Spirit of wine.
S. V. R., Spiritus vini rectificatus. Rectified spirit of wine.
S. V. T., Spiritus vini tenuis. Proof spirit.
Syr., syrupus. Syrup.
Tabel., tabella. A lozenge.
Temp. dext., tempori dextro. To the right temple.
T. O., tinctura opii. Tincture of opium.

T. O. C., tinctura opii camphorata. Camphorated tincture of opium.
Tra., tinctura. Tincture.
Ult. præscr., ultimo præscriptus. Last prescribed.
V. O. S., vitello ovi solutus. Dissolved in the yolk of an egg.
Vom. urg., vomitione urgente. The vomiting being troublesome.
V. S., venæsectio. Venesection.
V. S. B., venæsectio brachii. Bleeding from the arm.
Zr., zingiber. Ginger.

The *Signatura* is rarely written in Latin. It comprises the directions as to the dose and mode of administering the medicine, and is especially addressed to the patient, or those in attendance upon him. This should be distinctly written in familiar language. None of the reasons for the employment of a learned, or technical language, in the other portions of the prescription, apply to this; on the contrary, a due regard to the avoidance of mistakes by the apothecary, and by the patient or his attendant, forbids it. It is very common to omit this part of the prescription entirely, and to depend upon a verbal direction as to the use to be made of the medicine. Sometimes two boxes of pills are ordered for the same patient simultaneously, or at short intervals, without any reliable means of distinguishing them, and when they are to be renewed, the apothecary may confound them, in consequence of the patient sending the wrong box, or through a slight error in his own labelling. Of 500 prescriptions taken indiscriminately from the files of three different dispensing stores, I find 43 per cent. have no definite directions, and a considerable proportion have no *signatura*.

The practice of writing—"To be used as directed"—is equivalent to omitting this part of the prescription, and in labelling, this is adopted by the apothecary in all cases, where the physician has omitted giving any directions.

As an example of the results which may follow from this kind of direction, the following incident has been related by a professional friend: Two vials were in the chamber of a patient, each containing a fluidounce of liquid, and each about the same size; one contained sweet spirit of nitre, and the other blistering collodion. The spirit was to be given in teaspoonful doses occasionally, and the blistering liquid was of course to be applied externally. At twilight, the nurse, not noticing the difference in the color and consistency of the liquids, and finding them both labelled alike, put in the patient's mouth what she should have applied over her chest, thus producing a most distressing inflammation, which long deprived the poor patient of her proper food, and doubtless contributed to exhaust her struggling vitality.

The danger of this kind of mistake is lessened by using for any two prescriptions of very different properties, different kinds of vials; thus, for a preparation to be taken internally, a fluted flint vial, and for a liniment, one of the plain German flint, or better still, in the one case a round, and in the other an oval vial.

The only remaining part of the prescription to be mentioned, is the addition to the foregoing of the name or initials of the writer, and the date; of these, it may be remarked, that the *name* in full

is on every account preferable. In a large city, where there are hundreds of physicians, it is impossible for pharmacists, and much less all their assistants, to become familiar with the handwriting and initials of every one of them, to say nothing of those instances in which two or more have the same initials. Now if this practice of signing prescriptions has any utility at all, it must be that it should be understood by the apothecary, so that if he suspects an error, or requires any explanation, he may make the necessary inquiries to correct it, without interrogating his customer and exciting alarm. Besides, there are some dangerous substances, and such as are used for criminal purposes, that the druggist is only justified in vending by the sanction of a responsible name, and this name should, therefore, be clearly and intelligibly written.

The date of the prescription is almost universally written in numerals, at least in Philadelphia; this convenient fashion is probably owing, mainly, to a large number of eminent practitioners of the last generation being members of the Society of Friends, and to the wide diffusion of the peculiarities of this sect in the "Quaker City," and from it, as the centre of medical instruction, to other localities.

When the patient is in moderate circumstances, the physician indicates that fact to the apothecary by the letter P, in one of the lower corners of the paper. If very poor, P P is written; from a conscientious apothecary, either of these marks secures a reasonable reduction in the price charged, and its omission by the physician leads to suspicion that the patient is not deserving of special charity.

CHAPTER II.

ON THE ART OF SELECTING AND COMBINING MEDICINES.

The study of Materia Medica and Therapeutics is designed to acquaint the student with the uses and powers of remedies, and to prepare him to make a proper selection from these to meet the ever varying phases of diseases.

The importance of this kind of knowledge cannot be appreciated until the actual emergencies of practice arise, and the necessity becomes apparent of an extended and a thorough knowledge of the weapons for combating disease.

A full and recent treatise on Materia Medica should always be within reach of the physician, and one or more of the best medical journals should replenish his library with the most recent discoveries and improvements; nowhere can a professional man less afford to economize than in his books.

A very few years suffice to produce important changes, both in the theory and practice of medicine; and the physician who stands

still while progress is all around him can expect no better fate than that of the mechanic, the farmer, or the man of business who is content with the appliances of the past age in endeavoring to compete with those possessed of the facilities of the present.

While a sound conservatism, a becoming deference to those who have gone before us, and to the great medical authorities in our own time, should prevent a hasty departure from established principles or modes of treatment, there is a wide and profitable range for experiment in the vast extent and variety of the materia medica, and the combinations of which individual remedies are susceptible.

It is true that many skilful physicians employ a very restricted materia medica; there are hundreds in the United States who carry the weapons they use for treating the usual forms of disease, in some twenty or thirty vials, carried about their person or inclosed in a pair of saddle-bags; while, for unusual cases, they keep perhaps as many more on their office shelves. Though the frequent success of such, through skill and experience, cannot be questioned, we can draw no inferences from this fact to disparage the employment of an extended and varied assortment of remedies.

To what purpose has the bounty of nature spread everywhere plants of such varied and unsuspected properties; and why is art from the exhaustless mine of nature ever turning up some new product, endowed with varied, and, perhaps, health-restoring powers, if the physician, into whose special keeping the business of testing their virtues is given, neglects the injunction, "Prove all things; hold fast that which is good?"

In the foregoing remarks, I would not be understood as countenancing a departure from the usual materia medica, except where called for by the requirements of practice, and justified by sound discretion; and much less would I encourage any of those innovations upon well-established principles, which have taken shape in the various *pathies*, now so prevalent and so lamentably deficient in the indispensable elements of common sense and common honesty.

In the selection of medicines, then, let the physician have before his mind the whole materia medica, with a complete knowledge of which he should be equipped from the start. Let him *first* select an individual from its class, with a view to all its properties, as likely to affect the immediate symptoms he is combating, and the general result of the case; and *second*, let him select the best preparation of it with reference to efficiency, to safety, to physical properties, and to all other circumstances.

When there is a single medicine, which will fully meet the indication, there is no use of mixing it with others, except so far as its preparation in eligible form requires, as in the sequel; when there is an officinal preparation, whether simple or compound, which is adapted to the case, it is generally better to prescribe it by its officinal name, than to attempt a similar original combination; thus *Pilulæ catharticæ compositæ* are found to answer a common indication in diseases so very frequently, that they have almost superseded extemporaneous preparations of the same, or nearly the same in-

gredients ; this is the case, though to a less extent, of other officinal preparations. A common exception is furnished in *Pilulæ quiniæ sulphatis*, which are frequently prescribed extemporaneously, in proportions varying from the officinal in order to secure their being freshly prepared, and still more frequently varied somewhat in composition to secure greater solubility or adaptation to the case in hand.

Officinal preparations are best selected in emergencies, since they are ready without the delay of compounding them, while most forms of extemporaneous prescription require time for their preparation. Physicians should be somewhat influenced by economical motives, in prescribing for persons of moderate means ; preparations which are kept on hand by the apothecary, are cheaper than those which are mixed extemporaneously. In almost every class of medicines, there are those which are very costly ; and it is well when they can be superseded by others in prescribing for the poor. Many practitioners are in the habit of directing for such, the sulphate of cinchonia or chinoidine, instead of a salt of quinia ; a plan much resorted to by those residing in remote situations, who have to act as their own apothecaries, and find their practice among the poor a source of expense rather than revenue.

The Art of Combining Medicines.

Notwithstanding the advantage obtained by combining, in a single preparation, the virtues of several medicines, there is, I think, more danger of the inexperienced attempting complications not sanctioned by sound science, than of erring on the side of simplicity.

In the remarks which follow, I shall endeavor to treat methodically, and as briefly as possible, the several advantages to be attained by medicinal combinations, and the means by which they may be most readily and safely fulfilled ; and in the series of Prescriptions appended, shall endeavor further to illustrate the subject.

In compound prescriptions, we usually recognize one ingredient selected from the materia medica as the most important in a therapeutical point of view. This is designated as the *basis*. Sometimes two or three remedies may be combined to form the basis, but if they have different therapeutical effects, they are considered as *adjuvants*, *correctives*, *etc.*

Although this classification of ingredients is not absolute, it facilitates the study of the subject, and we proceed to notice—

First. The Objects to be attained by adding to the Basis.

Dilution.—A great many remedies are too strong to be eligible for use without the addition of a menstruum, to increase the dose and to allow a more ready division. In giving calomel, in very small alterative doses, it is impossible to apportion it properly without dilution with some suitable substance, such as sugar, sugar of milk, or gum Arabic. In using small doses of tartar emetic, sul-

phate of morphia, or other soluble salts, in the liquid form, it is usual to dilute them with water. In the case of concentrated liquid preparations, as tinctures of aconite root, nux vomica, etc., a less active liquid should generally be added, so as to bring the strength of the preparation to a less dangerous point, especially when prescribed for ignorant or careless persons.

The simple act of dilution may then be regarded as the first, though one of the least important objects in view, in adding to the basis or starting point of the prescription, and the substance so employed, if simply for this end, may be called the *diluent.* Many prescriptions consist merely of the basis and diluent.

To heighten or give Direction to the Effects of the Basis.—It was formerly considered that substances of similar therapeutical powers were mutually increased in energy by admixture. This idea is now generally abandoned, except in so far as the powers of medicines may be heightened by combining them with others capable of rendering the system more susceptible to their action, or of giving specific direction; thus, aromatic stimulants greatly heighten the effects of tonics, and will be found generally combined with them in tonic preparations. (*See* Tonic Tinctures and Prescriptions Nos. 7, 13, and 18.) Rhubarb, by its astringency, modifies the effects of other cathartics, as in Warner's Cordial. We have a further illustration of this in the use of tartar emetic, to give a sedative and diaphoretic direction to saline remedies; and of Dover's Powder, to render extract of colchicum more sedative, as in Prescription No. 34.

Not to multiply illustrations, many of which will be found in the context, it requires to be mentioned that, in some cases, the *adjuvant* may be best given at a different time from the basis, or rather, that the two may be most profitably separated. Thus, it is customary to purge a patient affected with intermittent before giving quinia; but few practitioners would combine the cathartic with the antiperiodic.

There are sometimes ingredients in a prescription which may be considered either in the light of adjuvants or of vehicles. Thus sulphuric acid in quinia solutions both adds to the effect, as is commonly considered, and affords a means of solution. So extracts, combined with other remedies, may heighten their action, while affording a convenient vehicle for making them into a pilular mass. The adjuvant is, however, rarely introduced, practitioners generally relying upon the independent action of one agent, modified, if required, by another, which is used for the next object.

To Correct some objectionable Property in one or both of the Active Ingredients.—The instances in which this motive for adding to the basis is called into play are fully illustrated in the prescriptions which follow. The combination of opium with calomel, in dysentery, is one of the strongest cases in point. The mercurial is, by this means, adapted to conditions of the system in which, if employed singly in the same dose, it might aggravate the symptoms. Certain effects of opium, as a basis, are obviated by correctives, as

compound spirit of ether, which is said to diminish its nauseating effect on the stomach.

In administering oil of turpentine, or wormseed oil, as a vermifuge, some corrective is needed which will insure a purgative effect, and prevent its undue absorption. Oil of turpentine and laudanum are used as correctives to castor oil, in irritable conditions of the bowels diminishing its purgative effects, and preventing griping. In prescribing senna, the custom is almost universal of adding some aromatic seed to the infusion, to prevent griping.

We may frequently make one substance answer the double purpose of a corrective, and diluent or vehicle. In this connection we find the medicated waters useful for liquid preparations; soap for pills; aromatics for powders; and certain stimulating oils in ointments and liniments.

It will be observed that the corrective may be either therapeutical or chemical in its operation, or both; while the effect of adding essential oils or opiates to cathartics, is purely therapeutical, that of combining soap with resins, to correct insolubility, is chemical or pharmaceutical. So, in combining mastich, or other insoluble resin with aloes, the effect of that cathartic is diminished and protracted, as in Chapman's Dinner Pill, and the officinal Pilulæ Aloes et Mastiche.

The proper incorporation of the ingredients together is an object of paramount importance in the preparation of medicines. The *excipient* added for this purpose may be either chemical or mechanical, or both; it may be connected with the therapeutic plan of the prescription, or may be added solely to make the preparation more agreeable to the taste, and more uniform in consistence. This ingredient is important to be designated by the physician, from the fact that it cannot always be left to the choice of the pharmacist, who is ignorant of the therapeutical indications, though his practical acquaintance with the subject would qualify him to select the best excipient. The rules that suggest themselves in regard to the proper incorporation of ingredients together can be best brought into view in connection with the different forms of medicines, which will next be treated of in detail, and in such rotation as experience has shown to be most convenient to the student.

CHAPTER III.

ON POWDERS, PILLS, SUPPOSITORIES, ETC.

Pulveres. (Powders.)

In the chapter on Drying and Powdering Drugs, etc., some general views are given on the utility of this form of preparation, but it yet remains to point out in a particular manner the uses of powders in extemporaneous prescribing.

1. *The kind of Substances adapted to this Form of Prescription.*

a. Those medicines which are insoluble; as calomel, phosphate of lime, subnitrate of bismuth, subcarbonate of iron, magnesia, etc.

b. Drugs possessing, in the natural condition, peculiar properties, differing from those which are artificially prepared from them; as cinchona, colomba, etc.

c. Those which, in solution, would possess more nauseous or bitter properties than in their undissolved, finely-divided condition; as sulphate of quinia, kino, catechu, etc. They are, for the most part, best suited for making into pills.

d. Those which, combined in a liquid form, would be chemically incompatible.

e. The extracts and blue mass, when dry enough to be reduced to powder.

2. *The kind of Substances unsuited to this Form.*

a. Deliquescent substances; as carb. potass, unless with special precautions.

b. Substances containing a large amount of water of crystallization (unless dried); as carbonate of sodium.

c. Substances, the active principles of which are very volatile; as valerian and assafœtida, unless dispensed in bottles.

d. Substances physically unsuited to mechanical division; as camphor and guaiacum, unless with certain precautions.

e. Blue mass, and the extracts in their usual condition, although the former and some of the latter are very convenient in the form of powder.

Powders may be prescribed suspended in the form of mixture or draught, always directing the bottle to be shaken before pouring out the dose; or in pill, if their dose is small. They are usually prescribed in papers (chartulas), each containing a dose, or in a single large package, the dose being indicated in the directions by some familiar standard of measurement.

Soluble substances, prescribed in powder, may be directed to be dissolved in water, and the solution taken in appropriate doses, so as to save expense to the patient, or to have the medicine in a more portable form, as in travelling. This, however, is apt to lead to mistakes unless accompanied by very specific directions. Seidlitz, soda, and citric fever powders are elegant forms for giving single doses of soluble salts.

When the dose of an insoluble powder is large, as in the case of magnesia, or of phosphate of calcium, and it is to be mixed by the patient or attendant, it is well to direct the particular mode of suspending it in water. The directions for magnesia are as follows:—

Put the requisite quantity of clear and cold water (not too much) in a clean glass, and drop into it from the blade of a knife or spoon, the required dose; allow it gradually to mix with the water and

subside, after which stir it up and drink immediately. This will be found more satisfactory than to pour the water upon the dry powder in the bottom of the glass.

Powders which are viscid and slightly soluble are, generally, more disagreeable than those which are not. Rhubarb is much less pleasant to take in fine powder than when chipped into very small shavings or grated, and suspended through a glass of water.

Some viscid vehicle seems quite necessary to heavy powders like calomel, or mercury with chalk, as by sinking to the bottom of the spoon from which administered, these are liable to miss of being swallowed.

With medicines prescribed in the form of powders, there is no occasion for the use of excipients, as they are not, strictly speaking, incorporated together; where the dose is small, however, an additional substance may be directed for the purpose of dilution, such as sugar, or a mixture of sugar and gum, or liquorice, or arrowroot fecula. In Castillon's Powders, an antacid and astringent, calculated to act as a remedy for the diseased condition, are combined with appropriate nutritious ingredients.

In Dover's Powder we have an instance of the diluent being made to subserve an important mechanical end; and I am informed by an intelligent pharmacist that, in his vicinity, physicians combine sugar of milk with powders in prescription for a like purpose, directing long trituration; calomel is said by this means to acquire increased efficiency where a rapid constitutional effect is desired. Although the assertions of homœopathists, in regard to the virtues of trituration are absurd, yet it is quite possible that, in a case like that of calomel, long attrition with a hard substance, in contact with the atmosphere, may produce chemical, as well as physical, changes of importance.

The use of adjuvants and correctives is appropriate in the case of powders, equally with other classes of remedies; and, by reference to the prescriptions appended, it will be observed that they are very commonly added.

Pilulæ.

Pills are the most popular and convenient of all forms of medicine. In common with powders, they have the advantage of being accurately divided, so that the patient is not dependent upon any of the uncertain means of approximate measurement necessary in administering liquids. They are also more portable. The contact is so slight with the organs of taste, in swallowing, that the most offensive substances can be swallowed in this form with comparatively little inconvenience. There are, however, a few people who cannot swallow them; this is the case, too, with young children, for whom some other form is preferable.

The size of pills is necessarily limited to from four to five grains of vegetable powders, or five to six grains of heavy mineral substances *including the excipient*, though these quantities are larger than usual.

The kind of Substances adapted to the Pilular Form.

a. All those suitable to the form of powders which are given in small doses.
b. The gum resins, balsams, and turpentine.
c. Substances the operation of which it is desirable to retard; as in certain aperient and alterative pills.
d. Insoluble substances, which are too heavy to give conveniently suspended in liquids.
e. Very disagreeable and fetid substances.
f. The vegetable extracts.

The kind of Substances unsuited to the Pilular Form.

a. Those which operate only in doses exceeding fifteen or twenty grains, or too large for three or four pills.
b. Deliquescent salts, and those containing a large proportion of water, unless this be suitably absorbed by associated dry powder.
c. Bodies of such consistence as to require an undue proportion of dry or viscid material to make a mass, except such as have a very small dose; as croton oil.
d. Very volatile substances; as carbonate of ammonium, except with certain precautions.
e. Those which are prescribed for immediate effect; as emetics and diffusible stimulants.
f. Essential oils, in quantity exceeding half a drop to each pill.

The formation of a pill mass is sometimes a matter of considerable difficulty, from a want of adhesiveness of the ingredients, or sometimes from the difficulty of incorporating them equally together. Under the head of The Art of Dispensing, some hints upon the mode of overcoming difficulties of this kind will be appropriate.

Should the physician indicate the excipient, or leave it optional with the apothecary? In answering this, we necessarily bring into view the therapeutical relations of this ingredient, and shall find that it may be active or inert, at the option of the prescriber.

If the basis be rhubarb or aloes, or a similar vegetable powder, a mass can be readily formed by moisture, without the aid of any adhesive material; if, on the contrary, it be a metallic salt, or an unadhesive vegetable powder, it requires an addition to give it the form of a mass; that addition will add to the bulk of the ingredients prescribed, and perhaps, if the dose be large, will make the pills too bulky; in this case, it is important that the physician should not overlook the excipient, which he may include among the medicinal ingredients, or make due allowance for, in apportioning the quantity to each pill.

The following rule for prescribing pills will obviate the disadvantage of adding to the size by the use of inert excipients: *when the basis is an unadhesive material, one of the other medicinal ingredients should be an extract or a vegetable powder, which will form a mass by moisture alone.*

Tabular View of Pharmaceutical Adaptations.

Medicines adapted to the form of Powder.

INSOLUBLE MINERAL SUBSTANCES, VEGETABLE PRODUCTS, AND SOME SOLUBLE SUBSTANCES.

INSOLUBLE; TOO LARGE DOSES FOR PILLS.	IN CERTAIN COMBINATIONS, AND WHEN PILLS ARE OBJECTED TO.
Carbo ligni.	Powd. pil. hydrarg.
Magnesia.	" ext. coloc. comp.
Calcii Phosph.	" opium.
Potass. bitart.	" digitalis.
Sulphur sublim.	" nux vom.
Creta ppt.	" kino.
Ferri subcarb.	" acid, tannic.
Ferri phosph. and others.	" " gallic.
Vegetable Powders:—	" " potas. nit.
Powd. cinchona.	Opium alkaloids.
" colomba.	Cinchona "
" gentian.	Subnit. bismuth.
" rhubarb (coarse).	Calomel,
" jalap.	and many others.
" cubebs,	
and others.	

Diluents for Substances prescribed in Form of Powders.

Sugar.	Aromatic powder.
Lactin.	Powd. ext. liquorice.
Mannite.	" tragacanth.
Powd. acacia.	" elm bark,
" cinnamon.	and others.

Medicines adapted to Pilular Form.

POWDERS GIVEN IN LESS THAN GR. XV DOSES, GUM RESINS, EXTRACTS; ALSO OLEORESINS AND OILS IN SMALL PROPORTION.

UNADHESIVE MATERIALS.	GOOD MEDICINAL EXCIPIENT.
Calomel.	Extracts.
Pulv. ipecac. et opii.	Pil. hydrarg.
Bismuth. subnit.	" copaibæ.
Morphiæ acetas, etc.	" ferri carb.
Strychnia.	Terebinthina.
Pulv. digitalis.	*With Moisture:*—
" ipecac.	Pulv. aloes.
Plumbi acetas.	" rhei.
Antim. et pot. tart.	" kino.
" sulphuret.	" acidi tannici.
Argenti nitras.	" opii.
" oxidum.	" scillæ.
Ferri pulvis.	Bebeerinæ, sulph.
" subcarb.	Ferri citras.
(other salts.)	Assafœtida, and others.
Potas. iodid.	*With Alcohol and Tinctures:*—
Camphor, and others.	Guaiacum.
Difficult to combine, except by Peculiar Treatment:—	Resinous Extracts,
Ol. tiglii.	and others.
" terebinth.	*With Dil.* H_2SO_4:—
Ferri iodidum.	Quiniæ sulph.
Copaiba, and others.	Cinchoniæ sulph.
	Quinidiæ sulph.
	Quinoidina.

Under the head of Dispensing Medicines, directions will be found for the granulation of powders and the coating of pills in such a way as to diminish their taste.

Excipients.

It will be proper in this connection to pass in review the several excipients, added with a view to giving body to pill masses, or adapting medicines to the pilular form, and to point out the special adaptations of each.

Soap, which is employed in the officinal pills more than any other excipient, is well adapted to combine with resinous substances, the solubility of which it increases, while it acts as an antacid, and perhaps aperient. It has been suggested, that it is incompatible with opium, with which it is prescribed in the officinal *pil. opii*, as the alkali, especially when present in excess, tends to separate the morphia from its native combination. Camphor is well combined with a mixture of soap and honey, and sometimes with an inert resin.

Syrup is often used as an excipient, which adds but little to the bulk of a pill mass, and is effectual in some cases, where water alone would not give the requisite tenacity; it does not answer a good purpose, however, with certain metallic salts, which dispose the mass to crumble.

Honey and *molasses*, uncrystallizable forms of sugar, are well adapted to the general purposes of pill making; masses made with these are not so liable to crumble, and possess the great advantage of remaining moist and soluble for a longer period. On account of the last-named property, honey is directed in the officinal recipe for sulphate of quinia pills. Honey, combined with tragacanth, is a very adhesive excipient for insoluble powders. Honey which has been evaporated to one-half its bulk is much better than before it is so treated, but honey, molasses, manna, and syrup are unsuitable excipients for those metallic salts that are liable to be reduced by the presence of sugar; calomel is a notable instance.

Glycerin (Bowers', preferably), ℥j, powdered tragacanth, whitest, 20 grains; rub these together in a mortar and put into a suitable recipient; after twenty-four hours it is fit to use. For further information on this subject, the reader is referred to 42d vol. *Amer. Journ. Pharmacy*, page 195. Soluble cream of tartar, with the twelfth of a grain of powdered gum tragacanth in each pill, has been much praised by Mr. J. B. Barnes, in a paper published in *Amer. Journ. Pharmacy*, vol. 44, page 17.

Gum Arabic is directed to be added, where the requisite adhesiveness will not result from the use of syrup or honey alone; it is not a very good excipient, whether added in the form of powder, or of a thick mucilage. Pills made with gum are apt to be very hard. Tragacanth forms a less hard and insoluble mass than acacia. The officinal syrup of gum Arabic is made with a special view to use in making pills.

Alcohol and *essential oils*, by softening down resinous substances,

facilitate their incorporation together in mass, and, being held by these with considerable tenacity, prevent their rapidly becoming too hard. Lactucarium may be brought to a pilular consistence by the use of a small proportion of *chloroform*, which rapidly evaporates, leaving the pills of an elegant consistence. Oil of turpentine is well adapted to softening white turpentine, so as to incorporate it with other ingredients, as in Otto's emmenagogue pills. These excipients must, however, be added with care, or they will render the mass quite too soft.

An important use of essential oils in pills is to prevent mouldiness, and the disagreeable odor which vegetable powders acquire when moistened; they should be added in very small proportion for this purpose, as they interfere with the adhesiveness of the mass.

Crumb of bread furnishes a convenient and tenacious vehicle for substances given in small dose, and which require diluting, rather than combining in a small bulk.

Confection of rose is adapted to similar uses, though more moist and of a less tough consistence. When made from the Rosa Gallica, it is astringent, and adapted to combining certain vegetable powders belonging to that class; as usually met with, however, it contains no tannin, being made from our common varieties of rose. Confection of orange-peel, and aromatic confection, are adapted to similar uses.

The Officinal Pill Masses.—These may be described in this place as preparations well adapted to use as excipients, though very frequently prescribed singly.

Pilulæ Hydrargyri, U. S. P.

This is the officinal designation of the preparation commonly called blue mass, which is directed in the *Pharmacopœia* to be divided into pills of three grains each; as usually kept by physicians and druggists in an undivided state, it is more appropriately called *Massa pilul. Hydrargyri*, mercurial mass. It is prepared by drug millers and chemical manufacturers, by triturating together, in appropriate mechanical contrivances, mercury, conserve of rose, liquorice root in powder, and some viscid material, as powdered althea root, in such proportion that three parts by weight of the mass shall contain one of mercury, thoroughly divided, and partly oxidized.

The process used in the U. S. Army Laboratory, while in operation, and elsewhere, consists of the rapid and continuous shaking of the mercury with a portion of honey in a strong bottle till it is extinguished, and the subsequent incorporation of the mixture with the powdered rose petals and liquorice root. The shaking is done by securing the bottle upon a wooden upright frame worked by the steam engine. In a few hours the semifluid mass is ready to mix with the dry powders, which is done by mixing in a kettle and successively passing the mass between rollers, frequently folding the thin sheets together till they are uniformly mixed.

To my former pupil, Thomas Weaver, the reader is indebted for the following good extemporaneous process for the preparation of a small quantity of this pill mass. Its importance as a practical improvement will be appreciated by those who have attempted to prepare blue mass with the pestle and mortar by the officinal process:—

Extemporaneous Blue Mass.

Take of Mercury	℥j.
Powdered liquorice root	ʒss.
Powdered rose leaves	ʒvj.
Honey	ʒvj.

Triturate the honey, liquorice root, and mercury, rapidly together for three minutes, or until all the globules of mercury disappear, then add the rose leaves, and work the whole into a uniform mass; if it is too stiff, moisten with a little water.

Powdered Blue Mass.

Take of Mercury	℥j.
Powdered liquorice root	ʒj.
Powdered rose leaves	ʒvj.
Simple syrup	f ʒij.

Triturate the mercury, one-fourth of the powdered liquorice root, and the simple syrup rapidly together for three minutes, or until the globules disappear, and then incorporate the powdered rose leaves, and the remainder of the powdered liquorice root, and spread the whole out to dry in a warm place. Reduce this to powder.

From specimens of blue mass which have been dried at a moderate heat, a very convenient powder may be prepared, which is well suited for conversion into the pilular form, and into compound powders.

Blue mass is, perhaps, the most popular, as it is the mildest form of mercurial preparation; it is well adapted to use in pill or powder, either combined, as in several prescriptions which follow, or singly, in doses of from one to ten grains.

Blue mass, when designed to act on the liver without producing a cathartic effect, may be combined with opium or a pure astringent. It is frequently, however, combined with vegetable cathartics, to increase its tendency to operate on the bowels. Perhaps a majority of the mild cathartic pills, prescribed by practitioners and those sold as universal remedies, contain this useful ingredient; and, in fact, blue pills are very commonly known and taken by those who prescribe for themselves for what is popularly known as "biliousness," and various forms of liver complaint.

Pilulæ Ferri Carbonatis, U. S. P.

Vallette's Mass is a very mild and soluble preparation of iron, made by incorporating freshly-precipitated protocarbonate of iron with honey, or some mixed saccharine vehicle, and by evaporation concentrating into a pilular mass. This may be taken by itself, in

a dose of from ten to thirty grains, or may be used as an adjuvant or vehicle to other medicinal substances, particularly dry powders, as in those numerous cases where iron, in small doses, is indicated along with bitter tonics. (*See* Preparations of Iron.)

Pilulæ Copaibæ, U. S. P.

Copaiba mass, although seldom employed as a vehicle, is not unsuited to this use; it is directed to be made by incorporating one drachm of calcined magnesia with two troyounces of copaiva, a recipe by which it is very difficult to get a sufficiently solid mass. The copaiva must be thick and resinoid, and the magnesia recently calcined, or the required thickening will not occur. The introduction of wax and some vegetable powder will be found an improvement. The dose is from five to ten grains.

The Extracts.

This class, which is well adapted to the pilular form, should not be overlooked in prescribing dry ingredients; some one extract can usually be selected which will meet a therapeutical indication, while it serves the purpose of an excipient.

Thus, in sedative or narcotic pills, we have the choice of five or six extracts to incorporate with any unadhesive or other material, so as to gain efficiency without too large a bulk. In directing a tonic remedy in this form, extract of gentian, quassia, cinchona, or nux vomica will come in play. While as a vehicle, for the mercurials in cutaneous or syphilitic diseases, extract of conium, or of sarsaparilla, may be used. The use of the cathartic extracts, and of extract of taraxacum for similar purposes, is too common to need comment. We have an elegant and efficient compound, made on this principle, in the so-called Dr. Vance's Gout Pills.

Formulary of Officinal and other Powders and Pills.

In the following officinal and extemporaneous prescriptions, some of which are selected from standard works, others from the prescription files of the dispensing establishment over which I preside, and a few of which I venture to offer for trial, the most approved methods of compounding medicines in the form of powders and pills are indicated.

When active remedies are prescribed in the form of powders, the diluent should be weighed first and a small portion of it thrown into the mortar and triturated till quite finely powdered; this will prevent the active remedy from adhering to the mortar; then the active ingredient, which should be well mixed, and the remainder of the diluent added and the trituration continued till a powder of proper fineness is obtained.

The accurate division of powders is facilitated by having a glass tile ruled into squares of one-fourth of an inch; the powder, being uniformly distributed over the surface of as many squares as there

are powders to be made, can be readily divided with great exactness by following the lines ruled with the spatula in making the division.

ASTRINGENTS.

No. 1.—*Powders used in Obstinate Diarrhœa.*

		Each Powder.
Take of Alum	ʒij	20 grs.
Kino	ʒss	5 grs.

Mix and reduce to a very fine powder, and distribute this into six papers. DOSE, one every two or three hours.

Alum and kino are incompatible in liquid form, and hence, when associated together, should always be prescribed in powder. The dose is too large for the pilular form.

No. 2.—*Pills of Tannic Acid.*

		Each Pill.
Take of Tanic acid	gr. xij	1 grain.
Confection of rose	gr. vj	½ grain.

Make a mass and divide into twelve pills. DOSE, one every two hours.

The above may be made into powders by substituting an aromatic, astringent, or inert powder for the confection.

No. 3.—*Astringent and Sedative Powders.*

		Each Powder.
Take of Tannic acid	℈j	2 grs.
Acetate of morphia	gr. j	$\frac{1}{10}$ gr.
Sugar	gr. x	1 gr.
Oil of caraway	♏j	trace.

Triturate together, and distribute into ten papers. DOSE, one every three hours.

Five grains of opium may be substituted for the morphia salt, or by the substitution of sufficient syrup for the sugar, the whole may be made into the pilular form.

No. 4.—*Chalk Powders.*

		Each.
Take of Prepared chalk	ʒij	15 grs.
Gum Arabic, in powder, Sugar, each	ʒj	$7\frac{1}{2}$ grs.
Cinnamon, in powder	gr. x	$1\frac{1}{4}$ grs.

Triturate together into a uniform powder, and divide into eight doses.

Chalk mixture spoils by keeping in hot weather, and is, moreover, much more bulky than an equal quantity of the ingredients in the above form, which is especially convenient for travellers. Opium, kino, or other remedies adapted to increase or modify its action, may be added in powder. One of the very best additions for a common form of diarrhœa is that of powdered blue mass, of which gr. xvj to ʒss may be added to the above.

No. 5.—*Antacid Powder with Opium and Blue Mass.*

		Each.
Take of Precipitated carbonate of calcium	ʒj	6 grains.
Tincture of opium	fʒj	6 minims.
Pulv. pil. hydrarg.	gr. x	1 grain.

Triturate in a mortar and expose till it is dry, then divide into ten powders. Dose, one every three hours until the symptoms are checked.

No. 6.—*Powders for the Diarrhœa of Infants.*

		Each.
Take of Acetate of lead	gr. ij	$\frac{1}{6}$ gr.
Opium	gr. ss	$\frac{1}{24}$ gr.
Camphor	gr. j	$\frac{1}{12}$ gr.
Sugar	gr. iij	$\frac{1}{4}$ gr.

Triturate, and divide into twelve papers. Dose, one every two or three hours. For adults, the whole quantity prescribed may be taken at one dose.

The child should be kept quiet, and fed upon arrowroot, flour boiled in milk, or a mixture of barley-water and cream.

No. 7.—*Pilul. Plumbi Acet.* (*University College, London.*)

		To Each.
Take of Acetate of lead	gr. vj	$\frac{1}{2}$ gr.
Muriate of morphia	gr. iij	$\frac{1}{4}$ gr.
Extract of hyoscyamus	gr. xxiv	2 grs.

Mix; make into twelve pills.

Tonics and Aromatics.

No. 8.—*Anti-Intermittent Powders.*

		Each.
Take of Powdered cinchona	ʒj	ʒj.
Powdered serpentaria	ʒij	gr. xv.
Sulphate of quinia	gr. viij	gr. j.

Mix, and distribute into eight papers. Dose, one every hour, commencing eight hours before the expected paroxysm.

The sulphate of quinia may be omitted, but is useful when the bark is not of the finest quality. The serpentaria may be replaced by more powerful stimulants, as cloves, or capsicum, or oil of black pepper; to obviate costiveness, a saline cathartic may be added.

No. 9.—*Pilulæ Quiniæ Sulphatis*, U. S. P.

		Reduced.	Each.
Take of Sulphate of quinia	ʒj	℈ij	1 gr.
Powdered gum Arabic	ʒij	gr. x	$\frac{1}{4}$ gr.
Clarified honey	q. s.	q. s.	

Mix the sulphate of quinia and gum Arabic, then beat them with clarified honey so as to make a mass, and divide into 480 pills (reduced quantity 40), of which the dose in intermittents is one every hour, between the paroxysms.

These officinal pills are less used than formerly for the full antiperiodic effect of the sulphate of quinia, as it is now customary to give large doses, less frequently repeated, and the officinal pills are found less convenient than pills or powders, of three, four, or five grains each.

Sulphate of quinia may be made into pills by the following process, which has been called Parrish's. (See paper by the author, in the *American Journal of Pharmacy*, vol. xxv. p. 291.)

No. 10.—*Pills of the Soluble Sulphate of Quinia.*

		Each.
Take of Sulphate of quinia	℈j	gr. v.
Aromatic sulphuric acid	♏xij.	♏iij.

Drop the acid upon the sulphate on a tile or slab, and triturate with a spatula, until it thickens and assumes a pilular consistence, then divide into four pills.

Persons not accustomed to this process sometimes allow the sulphate to become too dry and unadhesive to mould into pills. This is from not seizing the proper moment just as the mass has ceased to be too soft, and before it becomes dry; it is then quite plastic, and becomes particularly so by contact with the warmth and moisture of the thumb and fingers. A drop of syrup or honey, which should always be at hand on the counter, by being added at the proper moment, will prevent this hardening.

The five-grain quinine pill made in this way is not larger than many pills in common use; soluble quinine pills may be conveniently made of two, three, four, or five grains.

The large number of combinations in which sulphate of quinia is associated with other remedies cannot be here noticed; to some of these, as in combining the other alkaloids with it, the elixir of vitriol process is well adapted; in other cases it is inadmissible. If an extract in small quantity, or a vegetable powder, is to be added to the mass, it should be incorporated with the quinia salt, when by trituration on the slab it begins to thicken into a paste.

Sulphate of quinia will make a very good pill mass by using one grain of glacial phosphoric acid, or a quarter of a grain of tartaric acid, to each grain of the quinia salt.

No. 11.—*Pills of Sulphate of Cinchonia.*

		Each.
Take of Sulphate of cinchonia	℈j	gr. j.
Powdered tragacanth	gr. ij.	gr. $\frac{1}{10}$.

Triturate together, and add sufficient honey to make a mass, which divide into twenty pills; these pills are esteemed about equal to those of sulphate of quinia in most cases.

No. 12.—*Pills of Sulphate of Quinidia.*

		Each.
Take of Sulphate of quinidia	℈j	gr. j.
Powdered tragacanth	gr. ij.	gr. $\frac{1}{10}$.

Triturate together, and add honey sufficient to make a mass, which divide into twenty pills. These are esteemed about equal to sulphate of quinia pills of the same proportion.

No. 13.—*Pills of Chinoidine.*

		Each.
Take of Chinoidine	ʒj	3 grains.
Aromatic sulphuric acid	♏v or q. s.	trace.

Soften the chinoidine with the acid, in a mortar, and divide into twenty pills. Each pill is esteemed about equal to a one-grain quinia pill.

No. 14.—*Powders of Iron and Quinia.*

		Each.
Take of Subcarbonate of iron	ʒj	5 grs.
Sulphate of quinia	gr. vj	½ gr.
Aromatic powder	gr. xij	1 gr.

Triturate together, and distribute into twelve powders. Dose, a powder three times a day before meals.

The proportion of sulphate of quinia should be increased when it is to be employed in convalescence from intermittents.

No. 15.—*Pills of Proto-Carbonate of Iron and Quinia.*

		Each.
Take of Sulphate of quinia	℈j	1 gr.
Pill mass of carbonate of iron . . .	ʒj	3 grs.

Mix, and make into twenty pills. Dose, one twice or three times a day.

In this class of prescription, designed for anæmic conditions, the sulphates of cinchonia and quinidia, and of bebeerina, may generally be substituted for that of quinia without disadvantage.

No. 16.—*Pills of Quevenne's Iron.*

		Each.
Take of Reduced iron	gr. CC	2 grs.
Manna	gr. C	1 gr.

Triturate into a mass and divide into 100 pills.

Manna is an excellent excipient for Ferrum Redactum, and will answer in less proportion, if very small pills are desired; when not at hand, it may be superseded by honey and a little gum Arabic or tragacanth.

In a number of cases it will be desirable to introduce adjuvants, which may be in the form of extract. Extracts of conium, of aconite, cinchona, nux vomica, and quassia are favorite adjuvants with Quevenne's iron.

No. 17.—*Pulvis Aromaticus*, U. S. P.

Take of Cinnamon, in fine powder,
Ginger, in fine powder, each, two troyounces.
Cardamom, deprived of the capsules, and in fine powder,
Nutmeg, in fine powder, each, a troyounce.

Rub them together until they are thoroughly mixed.

In this preparation, the dry powders of cinnamon and ginger, if triturated with the oily nutmeg, grated, and the cardamom, coarsely powdered, enable us to reduce them to a fine condition; the whole should be passed through a sieve.

By trituration with honey, syrup of orange-peel, and saffron, this furnishes Confectio aromatica.

No. 18.—*Dr. Mitchell's Tonic Pills.*

		Each.
Take of Extract of quassia	gr. xxxvj	3 grs.
Extract of conium		$\frac{1}{4}$ gr.
Subcarbonate of iron, of each . . .	gr. iij	$\frac{1}{4}$ gr.

Make into a mass with a few drops of solution of arsenite of potassium (if required); then divide into twelve pills. Dose, a pill twice or three times daily.

No. 19.—*Tonic and Aromatic Pills.* (Dr. Parrish, Senior.)

		Each.
Take of Sulphate of quinia	gr. vj	$\frac{1}{4}$ gr.
Powdered capsicum		$\frac{1}{2}$ gr.
Mace		$\frac{1}{2}$ gr.
Powdered cloves		$\frac{1}{2}$ gr.
Carbonate of ammonium, each . .	gr. xij	$\frac{1}{2}$ gr.
Oil of caraway	gtt. vj	$\frac{1}{4}$ ♏.
Confection of rose	Sufficient.	q. s.

Form a uniform tenacious mass, and divide into twenty-four pills.

No. 20.—*Pills used in Obstinate Intermittents.* (Dr. Chapman.)

		Each.
Take of Sulphate of copper	gr. iij	$\frac{1}{4}$ gr.
Powdered opium	gr. iv	$\frac{1}{3}$ gr.
Powdered gum Arabic	gr. viij	$\frac{2}{3}$ gr.
Syrup	Sufficient.	

Make a mass, and divide into twelve pills. Dose, one every three hours.

No. 21.—*Pilulæ Ferri Compositæ*, U. S. P.

		Each.
Take of Myrrh, in fine powder	ʒij	$1\frac{1}{2}$ gr.
Carbonate of sodium		Fe,CO_3
Sulphate of iron, of each	ʒj	$\frac{3}{4}$ gr.
Syrup	q. s.	q. s.

Rub the myrrh first with the carbonate of sodium, and afterwards with the sulphate of iron until they are thoroughly mixed; then beat them with syrup so as to form a pilular mass, to be divided into eighty pills.

This pill is similar in composition to Griffith's Iron Mixture. Supposing a reaction to take place between the salts present, protocarbonate of iron would be produced, which, with the myrrh, forms an admirable remedy in chlorosis; a lump of fresh myrrh is to be preferred to the powdered article of commerce.

No. 22.—*Pilulæ Ferri Iodidi*, U. S. P. (Blancard's Pills.)

Take of Iodine, three hundred grains.
Iron, in the form of fine wire and cut in small pieces, one hundred and twenty grains.
Sugar, in fine powder,
Liquorice root, in fine powder, each, one hundred and ninety-two grains.
Liquorice, in fine powder,
Gum Arabic, in fine powder, each, forty-eight grains.
Reduced iron, ninety-six grains.
Water, a fluidounce and a half.

Mix the iodine with ten fluidrachms of the water in a glass flask, and gradually add the iron, agitating until the solution has become a light pea-green color; then filter into a porcelain capsule containing the reduced iron, and add the remainder of the water in order to wash the filter. Evaporate the solution till a pellicle forms, and add the remaining powders, previously mixed together; continue the evaporation by means of a water-bath, with constant stirring, until the mixture is reduced to a pilular consistence; lastly, divide into three hundred and eighty pills.

Dissolve sixty grains of balsam of Tolu in a fluidrachm of ether, shake the pills with the solution till they are uniformly coated, and put them on a plate of glass to dry, occasionally stirring them until the drying is completed. Keep the pills in a well-stopped bottle.

These pills, as prepared by the above new officinal formula, are devoid of the smell of iodine; and distilled water, rubbed with them and filtered, does not color solution of starch, or gives it only a slight blue tint. No other form of iodide of iron is so easily taken or so permanent.

No. 23.—*Permanent Iodide of Iron Pills.*

(Extemporaneous process of I. Coddington.)

Take of Iodine	50 grains.
Iron, reduced by hydrogen	25 grains.
Water	30 minims.
Althæa powder	60 grs. or q. s.

Triturate the iodine in the water and add the iron gradually; when the color becomes a dark gray and there ceases to be any indication of free iodine to starch water, add the althæa powder, taking care not to make the mass too stiff. Then roll it into sixty pills containing one grain of iodide of iron, each, with an excess of iron.

Iodine and iron may be combined in melted cocoa butter, which should be kept melted till the union is complete, and then made into pills, coated with sugar or some vegetable powder.

No. 24.—*Compound Pills of Iodide of Iron.*

(Prescribed by Dr. Buckler, of Baltimore.)

		Each Pill.
Take of Iodide of potassium	ʒij	2 grains.
Iodide of iron	ʒj	1 grain.
Iodine	gr vj	$\frac{1}{10}$ grain.
Extract of conium	ʒj	1 grain.

Triturate the iodide of potassium, iodide of iron, and iodine together with a few drops of water to the consistence of a soft paste, then add powdered gum Arabic in the proportion of half a grain to each pill, and rub into a smooth paste. Incorporate with the whole extract of conium and make into a *soft mass*, with a mixture of equal parts of finely powdered elm bark and liquorice root. Then divide into sixty pills.

No. 25.—*Pills of Chloride of Iron.* (J. T. Shinn.)

Take of Tincture of muriate of iron . . . . . f℥ij.

Evaporate nearly to dryness, and add—

Powdered althæa root . . . . . ℥ss.

Triturate into a pill mass, and divide into two hundred and forty pills, each of which represents about ten drops of the tincture. They should be kept and dispensed in vials.

No. 26.—*Powder for Chronic Indigestion and Gastric Irritability.*

		Each.
Take of Bismuthi subnitratis	℥j	10 grs.
Pulveris rhei		5 grs.
Pulveris aromatici, of each	℥ss	5 grs.

Misce et divide in chart. vj. *Signa.*—Take one before each meal.

Nervous Stimulants; Antispasmodics.

No. 27.—*Pilulæ Assafœtidæ*, U. S. P.

		Reduced.	Each.
Take of Assafœtida	℥iss	gr. xxxvj	gr. iij.
Soap, in fine powder . . .	℥ss	gr. xij	gr. j.

Beat them together with water, so as to form a pilular mass, to be divided into 240 pills. (The reduced quantity into 12 pills.) Dose, one to four pills.

No. 28.—*Pilulæ Aloes et Assafœtidæ*, U. S. P.

		Reduced.	Each.
Take of Socotrine aloes, in fine powder		gr. xvj	gr. 1⅓.
Assafœtida			gr. 1⅓.
Soap, in fine powder, each .	℥ss		gr. 1⅓.

Beat them together with water, so as to form a pilular mass, to be divided into 180 pills. (Reduced, 12 pills.) Dose, one to four pills.

No. 29.—*Pilulæ Galbani Compositæ*, U. S. P.

			Reduced.	Each.
Take of Galbanum				gr. 1½.
Myrrh, each	℥vj	each	gr. xviij	gr. 1½.
Assafœtida	℥ij		gr. vj	gr. ½.
Syrup	Sufficient		Sufficient	q. s.

Beat them together, so as to form a pilular mass, to be divided into 240 pills. (Reduced, 12 pills.) Dose, one to three pills.

No. 30.—*Dr. Otto's Antispasmodic Powders.*

Take of Black mustard seed,
Powdered sage,
Powdered ginger, equal parts by measure.

Mix thoroughly.

Dose, in epilepsy, three teaspoonfuls, for three mornings in succession; discontinue three; then give as before. To be moistened with water or molasses.

No. 31.—*Pills of Nitrate of Silver.*

Take of Nitrate of silver . . . . . ℈j.
Turpentine (terebinthina, *U. S.*) . . . . . ʒj.

Triturate, with the addition of a few drops of oil of turpentine if necessary, to make a uniform pilular mass, which divide into thirty pills.

Dose, in typhoid fever and epilepsy, one pill every three or four hours.

Arterial Stimulants.

This class of remedies is least adapted to the pilular form of any in the materia medica.

No. 32.—*Powders or Pills of Carbonate of Ammonia, etc.*

Take of Muriate of ammonium (granulated),
Dried carbonate of sodium, each . . . . . ℈ij.
Powdered capsicum . . . . . ℈j.

Triturate into a uniform fine powder, and divide into ten papers, which should be wrapped in tinfoil.

By the aid of moisture, these powders are made to react with each other and develop carbonate of ammonium. To make into pills, add a portion of firm and rather dry conserve of rose. Divide into twenty pills, and keep them in a vial.

A solution of mastich in ether is a good varnish for coating these and similar pills: they should be as dry as possible before using this varnish.

Cerebral Stimulants, or Narcotics.

No. 33.—*Pilulæ Opii*, U. S. P.

		Reduced.	Each.
Take of Opium in fine powder . . .	ʒj	gr. xij	gr. j.
Soap, in fine powder . . .	gr. xij	gr. iiss	gr. ¼.

Beat them together into a mass with water, and divide into 60 pills. (Reduced, 12.)

Old opium pills are sometimes in request, from their being better retained by an irritable stomach, and from the fact that by their more gradual solution, they affect more favorably the diseases of the lower intestine. The best way to make pills to be kept for this purpose is to select a portion of the solid mass in its natural and

plastic condition, and to divide it, without admixture, into the required number of pills; these, as they contract and harden, will become compact and of slow solubility.

No. 34.—*Pills of Camphor and Opium.*

		Each.
Take of Camphor	gr. xxiv	gr. 2.
Powdered opium	gr. vj	gr. ½.
Alcohol	gtt. vj	trace.
Confection of rose	q. s.	q. s.

Misce, et fiant, secundum artem, pilulæ xij. Dose, from one to two pills.

No. 35.—*Anodyne Pills.*

		Each.
Take of Acetate of morphia	gr. j	gr. ⅛.
Extract of hyoscyamus	gr. iv	gr. ½.

Triturate into a mass, and divide into eight pills. Dose, one pill, repeated if necessary.

These are very small, and are not astringent in their effects on the bowels.

No. 36.—*Pulvis Morphiæ Attenuatus.*

Take of Sulphate of morphia	gr. j.
Sugar of milk	gr. v.

Misce.

The sugar of milk should be first put into the mortar and broken into pieces as small as black mustard seeds, when the morphia salt should be added and the trituration continued until an impalpable powder has been obtained.

One grain is designed to be an equivalent to one grain of opium; it furnishes a convenient form for administering small doses of morphia in prescription.

No. 37.—*Pills of Extract of Indian Hemp.*

Take of Ext. cannabis, Pulv. saponis, āā	gr. xx.

Triturate the extract with the soap in a warm mortar till a good mass is formed, then divide into *forty* pills. Dose, one to three pills.

Rheumatism and Gout Pills.

No. 38.—"*Dr. Vance's Rheumatism and Gout Pills.*"

		Each.
Take of Extracti colchici	ʒss	gr. 1¼.
Pulveris ipecacuanhæ comp.	ʒiss, gr. vj	gr. iv.

Misce, et divide in pilulas xxiv. *Signa.*—Take two at night and one before breakfast and dinner.

This is a most valuable combination, having been found efficacious in a great many cases, both chronic and acute.

Similar combinations are used in the several London hospitals, as follows: *King's College*, to each pill, acet. ext. colch. 1 grain; to

Dover's powder, 3 grains. *St. George's*, acetic ext. colch. 1 gr.; to Dover's powder, 2½ grains. *Middlesex*, acetic ext. colch. 2 grs.; to Dover's powder, 3 grains. *London Hospital*, acet. ext. colch. ½ gr.; Dover's powder, ½ gr. (See *Squire's Hospital Pharmacopœia.*)

No. 39.—*Lartique's Gout Pills.*

		Each.
Take of Extracti colocynthidis compositi .	ʒiss, gr. vj	gr. 4.
Extracti colchici acetici	gr. x	gr. ⅔.
Extracti digitalis	gr. v	gr. ⅓.

Misce, fiat mass. in pilulas xxiv dividenda. Take two for a dose.

This is the common recipe in Philadelphia; according to Wittstein each of the French Lartique's pills contains 2 grains of powdered colchicum seed.

No. 40.—*Becquerel's Gout Pills.*

		Each pill.
Take of Sulphate of quinia	2 drahms	2⅓ grains.
Extract of digitalis	15 grains	$\frac{3}{10}$ grain.
Powd. colchicum seed	2 scruples	⅘ grain.

Mix, and divide into 50 pills. Dose, 1 to 3 pills for several days.

These pills are stated to have removed attacks of acute gout in seven or eight hours.

No. 41.—*Pil. Colchici c. Hydrarg.* (King's College, London.)

		Each.
Take of Acet. ext. colchicum	24 grains	2 grs.
Mercurial mass	36 grains	3 grs.

Mix. Make 12 pills.

"Excito-Motor Stimulants."

No. 42.—*Powders given in Uterine Hemorrhages.*

		Each.
Take of Ergot, freshly powdered . . .	ʒj	gr. 10.
Alum, in powder	℈j	gr. 3⅓.

Mix, and divide into six equal parts.

Arterial Sedatives.

No. 43.—*Powders of Nitre and Tartrate of Antimony.*

		Each.
Take of Tartrate of antimony and potassium .	gr. j	gr. ½.
Nitrate of potassium		gr. 2½.
Sugar, each	ʒss	gr. 2½.

Triturate into powder, and distribute equally into twelve papers.

Emetics.

No. 44.—*A Prompt and Efficient Emetic.*

		Each.
Take of Pulveris ipecacuanhæ	ʒss	gr. xv.
Antimonii et potassii tartratis . . .	gr. ij	gr. j.

Misce, et divide in pulveres ij. *Signa.*—Take one in a little molasses, or sugar and water, and follow it by a draught of warm water. If one powder does not produce the effect, the second may be taken soon after.

Sometimes *calomel* is added to emetic powders, and both a purgative and emetic effect are produced. Emetics, as such, are never given in pill.

Cathartics and Laxatives.

To this class belong six of the pills, and two of the compound powders of the *Pharmacopœia*.

No. 45.—*Pilulæ Rhei*, U. S. P.

		Reduced.	Each.
Take of Rhubarb, in powder	℥vj	gr. xxxvj	gr. 3.
Soap	℥ij	gr. xij	gr. 1.

Beat them with water, so as to form a mass, to be divided into 120 pills. (Reduced, into 12 pills.)

The following recipe will make an elegant rhubarb pill without the use of soap, which is objectionable as imparting a disposition to become mouldy, and produce an unpleasant odor when damp.

		Each.
Take of Powdered rhubarb	gr. xlviij	gr. iv.
Comp. tincture of cardamom	gtt. xlviij	gtt. iv.

Triturate into a mass, and divide into twelve pills.

No. 46.—*Pilulæ Rhei Compositæ*, U. S. P.

		Reduced.	Each.
Take of Rhubarb, in powder	ʒj	gr. xxiv	2 grs.
Aloes "	ʒvj	gr. xviij	1½ grs.
Myrrh "	ʒss	gr. xij	1 gr.
Oil of peppermint	fʒss	♏ij	⅛ ♏.

Beat them with water, so as to form a mass, to be divided into 240 pills. (Reduced, into 12 pills.)

No. 47.—*Pilulæ Aloës*, U. S. P.

		Reduced.	Each.
Take of Aloes, in powder			2 grs.
Soap, each	ʒj	℈ij	2 grs.

Beat them with water, so as to form a mass, to be divided into 240 pills. (Reduced, 20 pills.)

No. 48.—*Pilulæ Aloës et Myrrhæ*, U. S. P.

		Reduced.	Each.
Take of Aloes, in powder	ʒij	gr. xxiv	2 grs.
Myrrh "	ʒj	gr. xij	1 gr.
Saffron "	ʒss	gr. vj	½ gr.
Syrup, sufficient quantity		q. s.	

Beat the whole together so as to form a mass, to be divided into 480 pills. (Reduced, 12 pills.)

A tonic and emmenagogue cathartic, known as Rufus's pills. Saffron may be reduced to powder by heating it in a capsule till it becomes crisp, then triturating in a mortar.

No. 49.—*Dr. Chapman's Dinner Pills.*

		Reduced.	Each.
Take of Powdered aloes			1½ gr.
" mastich, of each .	ʒij	gr. xviij	1½ gr.
" ipecac.	℈iv	gr. xij	1 gr.
Oil of caraway	♏xij	♏ij	Trace.

Mix, and make into mass with water, and divide into eighty pills. (Reduced quantity, twelve pills.)

These pills are much used in habitual costiveness; the presence of the mastich protracts the solvent action of the fluids upon the aloes, so that one pill, which is a dose, taken before dinner, will produce a gentle operation the next morning.

No. 50.—*Pilulæ Aloës et Mastiches*, U. S. P. (Lady Webster's Pills.)

Take of Socotrine aloes, in fine powder, a troyounce and a half	1⅘ gr.
Mastich, in fine powder,	
Red rose, in fine powder, each, half a troyounce	⅗ gr.

Beat them together with water, so as to form a pilular mass, to be divided into 400 pills.

This is now an officinal preparation, which has long been known as a popular remedy for costiveness. One or two taken before dinner will usually produce an evacuation on the following day.

No. 51.—*Dr. Mitchell's Aperient Pills.*

		Each.
Take of Pulveris aloes	gr. xij	1 gr.
" rhei	gr. xxiv	2 grs.
Hydrarg. chlor. mit.	gr. ij	⅙ gr.
Antim. et potas. tart.	gr. j	1/12 gr.

Misce, fiant pilulæ No. xij.

One acts as an aperient, two or three as a cathartic.

No. 52.—*Laxative Tonic Pills.* (Dr. Parrish, Sen.)

		Each.
Take of Powdered Socotrine aloes	ʒij	1 gr.
" rhubarb	ʒiv	2 grs.
Oil of caraway	gtt. xij	⅓ drop.
Extract of gentian	ʒij	1 gr.

Make into forty pills. Dose, two before dinner.

No. 53.—*Pulvis Aloës et Canellæ*, U. S. P. (*Hiera Picra.*)

		Reduced.
Take of Socotrine aloes, in fine powder . .	℥xij	℥iss.
Canella, in fine powder	ʒiij	ʒiij.

Rub them together until they are thoroughly mixed.

Hiera picra is generally macerated in some kind of spirit, and taken in draughts as a stomachic laxative.

No. 54.—*Pulvis Jalapæ Compositus*, U. S. P.

Take of Jalap, in fine powder . . . . . ℥j.
Bitartrate of potassium, in fine powder . . . . ℥ij.

Mix them.

This is a mild laxative, given in doses of gr. xv to ʒss. Sulphur and bitartrate of potassium are much associated in about equal bulks.

No. 55.—*Calomel and Jalap Powder.*

Take of Hydrargyri chloridi mitis . . . . . gr. xv.
Pulveris jalapæ . . . . . ℈j.

Misce.—To be given at a dose.

In the same way rhubarb is very commonly associated with calomel.

No. 56.—*Pulvis Rhei Compositus*, U. S. P.

	For one dose.
Take of Rhubarb, in fine powder, four troyounces . . .	gr. xv.
Magnesia, twelve troyounces	gr. xlv.
Ginger, in fine powder, two troyounces	gr. viiss.

Rub them together until they are thoroughly mixed.

This was a new officinal compound powder in 1860, which is well adapted to use as a laxative and antacid. Charcoal and magnesia are much used for a similar purpose.

No. 57.—*Neutralizing Powder.*

Take of Bicarbonate of sodium,
Powdered rhubarb,
Powdered mint (the herb) . . . . . Equal parts.

Rub the mixed ingredients through a sieve of sixty meshes to the linear inch.

Dose, a teaspoonful as an antacid remedy in diarrhœa and dyspepsia.

No. 58.—*Pulveres Effervescentes Aperientes*, U. S. P. (*Seidlitz Powders.*)

	Each powder.
Take of Bicarbonate of sodium, in fine powder, a troyounce	℈ij.
Tartrate of potassium and sodium, in fine powder, three troyounces	ʒij.
Tartaric acid, in fine powder, four hundred and twenty grains	gr. xxxv.

Mix intimately the bicarbonate of sodium with the tartrate of potassium and sodium, and divide this mixture into twelve equal parts. Then divide the tartaric acid into the same number of equal parts. Lastly, keep the parts severally of the mixture and of the acid in separate papers of different colors.

The character of the paper used for dispensing Seidlitz powders is very important; a rag blue indigo-dyed paper is the proper one, its color being permanent, and a glazed well-calendered white paper is the most appropriate for containing the acid. Tin boxes are best

for keeping them in, as pasteboard, if placed on a damp or wet substance, will be softened, and the contained powders injured.

Directions for Use.—Take two glasses with about a gill of cold water in each, dissolve in one the contents of the blue, and in the other of the white paper, mix, and drink immediately.

No. 59.—*Pills for Habitual Costiveness.* (Dr. E. Cutter, Woburn, Mass.)

Take of Pulv. ipecacuanhæ		gr. x.
Hydrarg. chlor. mit.		gr. iij.
Ext. taraxaci		℈ij.

Misce.—Ft. pilulæ. No. xxx.

Dose, one three times a day. A mild and effectual remedy for a very common symptom.

No. 60.—*Pilulæ Catharticæ Compositæ*, U. S. P.

		Each.
Take of Compound extract of colocynth	gr. xxxij	1⅓ gr.
Extract of jalap, in fine powder		1 gr.
Mild chloride of mercury, each	gr. xxiv	1 gr.
Gamboge, in powder	gr. vj	¼ gr.

Mix the powders together; then with water form a pilular mass, to be divided into 24 pills.

These well-known and popular pills are very easy to make, if the extracts, both of colocynth and jalap, are of proper consistence, or powdered before being incorporated with the other ingredients; but if the extract of jalap is of a tough consistence, which it frequently reaches by partial drying, it is almost impossible to incorporate it with the other ingredients. Powdered extract of jalap, when obtainable, may be kept in a salt-mouth bottle like any other powder, and a few drops of moisture will form it into a plastic mass. The tough extract should be further dried and powdered, or may be softened by heating and triturating in a capsule with diluted alcohol.

Under the name of *Antibilious pills*, this preparation, of more or less perfect quality, is vended in great quantities over the country, and by its admirable combination of cathartic properties is well adapted to supersede, as a popular remedy, the numerous nostrums advertised and sold for similar purposes.

No. 61.—*Pills of Colocynth and Hyoscyamus.* (Middlesex Hospital, London.)

		Each.
Take of Extracti colocynthidis compositæ	ʒss	3 grs.
Extracti hyoscyami	℈j	2 grs.

M.—Ft. pilulæ x. Dose, one to three pills.

No. 62.—*Tonic Pills of Podophyllin.*

		Each.
Take of Podophyllin	gr. ij	⅓ grain.
Powd. rhubarb	gr. xviij	3 grains.
Powd. capsicum	gr. iv	⅔ grain.

Mix and make into six pills.

Dose, one to two.

To produce ptyalism podophyllin should be combined with opium in small doses frequently and continuously.

No. 63.—*Modified Cathartic Pills.* (E. Parrish.)

		Each.
Take of Gamboge, in powder	gr. v	¼ grain.
Podophyllin, in powder	gr. ij	$\frac{1}{10}$ grain.
Aloes, in powder	gr. xxx	1½ grain.
Calomel	gr. xx	1 grain.
Ginger, in powder,		
Capsicum, in powder, each	gr. ij	$\frac{1}{10}$ grain.
Fluid extract of podophyllum, sufficient.		

Mix the dry powders, and triturate with the fluid extract into a pilular mass; divide this into twenty pills.

The object of this formula, prepared for a physician in the West, is to furnish an *Antibilious pill* the ingredients of which are readily obtainable, genuine, and of good quality. The difficulties met with by practitioners, in procuring the costly extracts of colocynth and of jalap of standard quality, have led to inquiries for a modified formula with cheap and common materials.

No. 64.—*Pills of Alöin and Podophyllin.*

		Each.
Take of Alöin	gr. xxiv	1 grain.
Podophyllin	gr. xij	½ grain.
Oleoresin of ginger	♏ iv	$\frac{1}{6}$ minim.

Triturate the solid ingredients into a uniform powder, add the oleoresin or piperoid of ginger, make a mass, and divide into twenty-four pills. Dose, from one to three.

No. 65.—*Dr. Alberti's Small Antibilious Pills.*

		Each.
Take of Calomelanos	gr. x	⅓ gr.
Pulv. gambogiæ	gr. v	$\frac{1}{6}$ gr.

Misce et fiant pilulæ xxx. Dose, two or three pills.

No. 66.—*Pills of Croton Oil.*

		Each.
Take of Croton oil	♏ iv	♏ ¼.
Crumb of bread	gr. xvj	gr. j.

Make into sixteen pills.

Croton oil and castor oil are both capable of forming soaps with caustic soda, which, being purified by solution in alcohol, and solidified in moulds, are eligible cathartic preparations.

Diuretics and Expectorants.

These classes of medicines are very little given in the form of pill or powder.

No. 67.—*Pilulæ Scillæ Compositæ*, U. S. P.

		Reduced.	Each.
Take of Squill, in fine powder	ʒj	gr. vj	½ gr.
Ginger, in fine powder	ʒij	gr. xij	1 gr.
Ammoniac, in fine powder	ʒij	gr. xij	1 gr.
Soap, in fine powder	ʒiij	gr. xviij	1½ gr.
Syrup, a sufficient quantity.			q. s.

Mix the powders, then beat them with the syrup so as to form a pilular mass, to be divided into 120 pills. (Twelve pills for the reduced quantity.)

Soap and syrup seem a poor kind of mixture, especially as either would be a sufficient excipient without the other; the pills are so large that the syrup is not only unnecessary but renders the pill larger than if made with water.

No. 68.—*Aromatic Pills.* (*Mütter's.*)

Take of Oil of copaiva,	
Oil of cubebs,	
Oil of turpentine, each	fʒj.
Magnesia	ʒij.

Mix, and form sixty pills.

Some recipes direct 4 grains of powdered opium to this number. They would be improved in a pharmaceutical aspect by substituting copaiva and Venice turpentine for the oils of copaiva and turpentine. One drachm of white turpentine is necessary to form the mass. The dose is two pills three times a day in gonorrhœa.

M. Ricord prescribes tar and copaiva combined; they are said to neutralize each other's noxious tastes and to be less liable to disagree with the patient than copaiva alone. The proportions of this mixture are 275 parts of copaiva to 35 of tar and 25 of magnesia.

No. 69.—*Compound Copaiva Pills.*

Take of Copaiva	ʒij
Powdered cubebs	ʒiijss.
Wax	ʒj.

By a gentle heat melt the wax, then add the copaiva, and immediately afterwards sift in the cubebs, stirring thoroughly. While it is yet warm, roll out and divide into 100 pills.

Diaphoretics, etc.

No. 70.—*Pulvis Ipecacuanhæ Compositus*, U. S. P. (*Dover's Powder.*)

(Pulvis Ipecacuanhæ et Opii, U. S. P. 1850.)

		Reduced.
Take of Ipecacuanha, in fine powder		gr. j.
Opium, dried and in fine powder, each	ʒj	gr. j.
Sulphate of potassium	ʒj	gr. viij.

Rub them together into a very fine powder. Dose, ten grains, the reduced quantity in the above recipe.

This valuable preparation is too well known to require much comment; it is used in a great variety of cases in which a sedative diaphoretic is indicated. It should be remembered that the opium is to be dried before being weighed, otherwise the powder will be deficient in strength. It should also be well and thoroughly triturated from containing hard crystals to an almost impalpable powder. It is said to be less liable to nauseate in the form of pills, which may be made with some suitable extract or with honey, to contain 3 to 4 grains of the powder.

Alteratives.

No. 71.—*Pilulæ Antimonii Compositæ*, U. S. P. (Plummer's Pills.)

		Each.
Take of Sulphurated antimony		½ grain.
Mild chloride of mercury, each, one hundred and twenty grains . . .	(ʒij)	½ grain.
Guaiac, in fine powder		1 grain.
Molasses, each, half a troyounce . .	(ʒss)	1 grain.

Rub the sulphurated antimony first with the mild chloride of mercury and afterwards with the guaiac and molasses so as to form a pilular mass. To be divided into 240 pills.

This is a new officinal, though long known and much employed in England, where it is known as the *compound calomel pill*. Sulphurated antimony is the new name given to the precipitated sulphuret of former *Pharmacopœias*.

Dose of the pills, from one to two twice a day, as a powerful alterative.

No. 72.—*Compound Pills of Iodide of Mercury.*

		Each.
Take of Green iodide of mercury	gr. x	½ gr.
Resin of guaiacum	ʒij	2 gr.
Extract of conium	ʒss	1½ gr.

Triturate the resin of guaiacum into a mass with a little alcohol, then incorporate with it the extract of conium and iodide of mercury, and divide into twenty pills.

These pills are alterative, and may be used in scrofulous and skin diseases. Extract of sarsaparilla may be added to, or substituted for, some of the other ingredients.

No. 73.—*Alterative Powders of Calomel.*

		Each.
Take of Hydrargyri chloridi mitis	gr. j.	½.
Sacchari	gr. xj	½.

Misce, fiat pulvis in chartulas xij dividenda.

Signa.—Take one every hour (or two hours), till the gums are touched.

When there is a disposition to undue purging, from gr. ss to gr. ij of powdered opium may be added to the above quantities.

No. 74.—*Pil. Hydrarg. Bichlorid.* (Westminster Hospital.)

		One pill.
Take of Corrosive sublimate	Three grains.	⅛ grain.
Muriate of ammonium . . .	Four grains.	⅙ grain.
Crumb of bread	Sufficient.	

Mix. Make into 24 pills. Dose one pill three times a day.

Emmenagogues.

No. 75.—*Dr. Otto's Emmenagogue Pills.*

Take of Dried sulphate of iron	gr. xlviij.
Aloes, in powder	gr. xij.
Turpentine	gr. xxxij.
Oil of turpentine	gtt. x or q. s.

Make a mass, and divide into thirty pills. Dose, two, three times a day.

Prescribed originally by the late Dr. J. C. Otto, and very freqently by the late Dr. Isaac Parrish. A similar recipe is often directed by Dr. Pepper, in the Pennsylvania Hospital Clinique.

The cautious addition of oil of turpentine insures an adhesive and plastic mass.

Numerous pills containing aloes, myrrh, and iron, given under the head of tonics and cathartics, are much used as emmenagogues. (*See* also Hooper's Female Pills, among the patent medicines.)

Trochisci.—Lozenges.

In addition to the description of this class of preparations at page 788, etc., I append the following as an example of the mode of prescribing them extemporaneously:—

No. 76.—*Prescription for Diaphoretic Lozenges.*

			Each.
Take of	Pulv. ipecac.	gr. vj	¼ gr.
	Potass. citrat.	ʒj	2½ gr.
	P. ext. glycyrrh.		4 gr.
	Pulv. acaciæ, āā	ʒj, ℈ij	4 gr.
	Tinct. Tolutani	gtt. vj	¼ drop.

M.—Ft. trochisci xxiv. Dose, for a child, one every two hours.

The mode of dividing this mass after rolling it into a rectangular sheet may be to cut it equally into six oblong sheets, each of which may be cut into four equal parts by a spatula, the surface being dusted with powdered liquorice or sugar.

Panis Laxans. Laxative Cake.

This preparation, which is somewhat used abroad, has not, I believe, been introduced into the United States. It is prepared by painting the under side of small biscuits with an alcoholic solution of jalap resin, 2 grains of the resin to each, and covering the surface with a thin layer of a mixture consisting of white of egg, sugar, and a little tragacanth, beaten together. The dose is 2 or 3 cakes for a grown person, 1 for a child of 6 to 8 years. The substitution of resin of podophyllum would be an improvement, on the score of cheapness.

Granules or Pellets.

This species of preparation was introduced into practice by the homœopathic practitioners, and, as applied to some powerful remedies, has been introduced into regular practice. Sugar granules are made by the confectioner. They are medicated by the pharmacist as follows: The dose to be contained in each granule is first determined; the required quantity of the medicinal substance is now dissolved in strong alcohol or ether, sufficient to moisten the requisite quantity of pellets; these being now counted out are to be agitated with the solution in a shallow dish till it is equally divided

among them and until the solvent has evaporated. The granules are liable to vary somewhat in the quantity of the absorbed solution, and it is therefore important that the agitation be continued without intermission until no trace of moisture can be detected; the employment of the strongest alcohol or ether is necessary, so that a larger amount of the solvent may be employed without liquefying the sugar. Such medicines only are prepared in this way as are given in very small doses, and the vegetable alkalies and neutral principles are particularly adapted to it. Generally, more than one of the granules contain the full dose of the medicine. It has become customary to have them contain the one-hundredth, one-fiftieth, one-twentieth, or the one-sixteenth part of a grain of the medicinal compound.

It should be borne in mind that the granules here described must not be confounded with those made by pharmacists of known and respectable standing; the process pursued in making them is the same as that in use in making pills; after the formation and division of the mass the granules are coated with sugar, and thus rendered acceptable to the palate and stomach of the most fastidious.

Suppositories.

These are rounded, generally elongated, masses, designed to be inserted into the rectum for the purpose of affecting the lower intestine, or, by absorption, the system generally.

No. 77.—*Pilulæ Saponis Compositæ*, U. S. P.

Take of Opium, in fine powder, sixty grains.
Soap, in fine powder, half a troyounce.

Beat them together with water, so as to form a pilular mass.

The foregoing and simple soap suppositories are formed by cutting the mass and rolling it into convenient shapes. Suppositories are also prepared from honey, by boiling down this substance till it becomes sufficiently hard to retain its shape. There are also formulas given in the books for several anthelmintic, anti-hemorrhoidal, astringent, emmenagogue, laxative, and vaginal suppositories, as well as for belladonna, calomel, cicuta, mercurial, and quinine suppositories.

From Gray's *Supplement to the Pharmacopœia*, the following formula for an anthelmintic suppository, taken from the *Codex Medic. Hamburg*, 1845, is selected.

No. 78.—Take of Aloes . . . . . ℥vj.
Common salt. . . . . ℥iss.
Spanish soap. . . . . ℥iss.
Starch . . . . . ℥viij.

Mix and make into a mass with honey, and then form into cones of the required size.

No. 79.—*Anthelmintic Suppositories.*

Take of Aloes, in powder . . . . . ℥ss.
Chloride of sodium . . . . . ℥iij.
Flour . . . . . ℥ij.
Honey . . . . . Sufficient.

Form into a firm paste, and make into twelve suppositories. Used in the treatment of *ascarides*.

The following syllabus exhibits the composition of the suppositories directed in the last edition of the *U. S.* and *British Pharmacopœias*.

Remedy.	Excipient.
Suppositoria Acidi Carbolici, gr. 12, U. S. P.	Oil of Theobroma, 360 gr., 12 suppositories.
" " Tannici, gr. 30, "	" " 300 gr., 12 "
" " " gr. 36, Ph. Br.	" " Benzoated lard and white wax, 12 suppositories.
" Aloes, gr. 60, U. S. P.	" " 300 gr., 12 suppositories.
" Assafœtidæ (Tr. f℥j), U. S. P.	" " 320 gr., 12 "
" Belladonnæ (Ex. gr. 6), "	" " 354 gr., 12 "
" Hydrar. (Ung. gr. 60), Ph. Br.	" " Benzoated lard and white wax, 12 suppositories.
" Morphiæ (Mur. gr. 6), "	" " Benzoated lard and white wax, 12 suppositories.
" Morphiæ (Sul. gr. 6), U. S. P.	" " 354 gr., 12 suppositories.
" Opii (Extr. gr. 12), "	" " 348 gr., 12 "
" Plumbi (Acet. gr. 36), "	" " 324 gr., 12 "
" Plumbi Comp., Ph. Br. { " Acet. gr. 36 / Opii Pulv. gr. 12 }	" " Benzoated lard and white wax, 12 suppositories.
" Plumbi et Opii, U. S. P. { Plumbi Acet. gr. 36 / Opii Extr. gr. 6 }	" " 318 grains.

The following directions are given in the *U. S. Pharmacopœia:* Mix the medicinal portion with a small quantity of oil of theobroma by rubbing them together, and add the mixture to the remainder of the oil of theobroma previously melted and cooled to the temperature of 95°. Then mix thoroughly without applying more heat, and immediately pour into suitable moulds having the capacity of thirty grains each. The moulds, having been previously made cold, must be kept so by immersion in iced water. All difficulty in removing suppositories from the moulds may be obviated by having the moulds previously dusted with lycopodium. In the absence of suitable moulds, suppositories may be formed by allowing the mixture, prepared as above, to cool, care being taken to keep the ingredients well mixed, and dividing it into parts, each of which shall weigh thirty grains, and may be made into a conical or other convenient form for a suppository.

Medicated Suppositories of Cocoa-butter.

Since the recent general introduction of suppositories in Philadelphia, attention has been increasingly turned to the use of cocoa-butter, as a vehicle for all the remedies prescribed in that form; this fat is, however, rather too soft for such use without admixture. Dorvault directs about an eighth part, by weight, of wax to be added, to impart the proper hardness. Common tallow, mixed with the same proportion of wax, serves as a cheap, though perhaps

inferior substitute. In the chapter on Dispensing, full directions are given for the preparation of these.

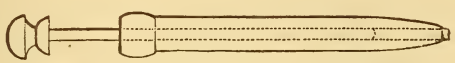
The following proportions are used in Philadelphia, but the medicinal ingredients may be mixed and varied to any extent.

Cocoa-butter alone,			
and combined with		Extract of opium	½ to 2 grains.
"	"	Acetate of morphia,	¼ to ½ grain.
"	"	Extract of belladonna,	½ to 1 grain.
"	"	Tannic acid,	3 to 5 grains.
"	"	Acetate of lead,	3 to 5 grains.
"	"	Monsell's salt,	1 to 3 grains.
"	"	Santonine,	1 to 3 grains.
"	"	Sulphate of quinia,	1 to 5 grains.
"	"	Podophyllin,	1 to 2 grains.
"	"	Mercurial ointment,	5 grains.

Some pharmacists issue catalogues of suppositories with numbers affixed to each formula, by which it is designed they shall be prescribed; there seems no advantage in this method to compensate for its liability to lead to confusion and mistakes. (*See* paper on this subject by E. Parrish and W. C. Bakes, *American Journal of Pharmacy*, 1861, p. 5; also paper by W. C. Bakes, 1863, p. 228; also the chapter on the Art of Dispensing.)

In the occasional instances in which it is desirable to thrust the suppository some distance above the external orifice of the rectum, the instrument here figured may be used; it is made of syringe-

Fig. 245.



Tube and piston for introducing suppositories.

metal, or of wood. A. B. Taylor, in the *American Journal of Pharmacy*, vol. xxxiii. p. 202, has figured a metallic piston, called a "suppositer," adapted to introduce suppositories, having a smaller cylindrical termination at the base of the cone, such as he prepares, but it is not adapted to the ordinary shaped cones.

CHAPTER IV.

LIQUID PREPARATIONS, SOLUTIONS, MIXTURES, ETC.

The term mixture is applied strictly to those liquids in which insoluble substances are suspended, but, in a more general sense, to all liquid medicines not included in one of the several classes of solutions, infusions, tinctures, etc. In the present chapter I shall for convenience include all extemporaneous preparations prescribed for internal use in the liquid form, endeavoring to adopt such a

classification as will aid the student in acquiring a knowledge of the principles which should guide the practitioner in their composition.

The hints given towards the preparation of ingredients into the form of pills are generally quite reversed in the case of mixtures, which should mostly be composed of substances in part or entirely soluble, or by their lightness readily diffusible in water. In mixtures, the use of excipients is not limited, as in the other case, by the necessity of not exceeding a certain bulk, but they may be freely added with a view of improving the composition physically, pharmaceutically, and therapeutically, and within certain pretty wide bounds, while the range of medicinal agents prescribed is enlarged by the addition of a great number of fluids, as the fixed and essential oils, ethers, solutions of ammonia, etc. There are reasons, however, which make the art of combining in the liquid much more difficult than in the solid form. In the presence of water, the great neutral solvent, the chemical affinities of various saline ingredients are fully brought into play, which, when in a dry or even a plastic condition, are without action upon each other; again, the physical difficulties to be overcome in this form of preparation are greater than in the foregoing, because the variety of materials to be combined is increased. The proper suspension of fixed and essential oils, for instance, is a matter of no little skill, and the division and diffusion of various powders require judgment and skill attainable by a familiarity with their physical properties.

There is also in the introduction of excipients and adjuvants, great scope for the exercise of ingenuity, to improve not only the flavor, but the appearance of mixtures.

Next to a considerable range of practice in the composition of mixtures, I know of no better way to become familiar with the subject, than by a study of the syllabus like that here presented, together with a number of approved formulas, such as are grouped together in this chapter.

Medicines suited to Liquid Form.

MOST SOLUBLE SALTS, LIGHT INSOLUBLE POWDERS, EXTRACTS, GUM RESINS, FIXED AND ESSENTIAL OILS, AND ALL THE GALENICAL SOLUTIONS.

SOLUBLE.

FORMING ELIGIBLE SOLUTIONS WITH WATER.

Alumen.
Ammon. murias.
Antim. et potass. tart.
Barii chloridum.
Calcii chloridum.
" hypophosphis.
Ferri sulphas.
" et pot. tartras.
" pyrophosphas.
Manganesii sulphas.
Magnesii sulphas.
Potassii acetas.
" bicarbonas.
" carbonas.
" citras.
" chloras.
" hypophosphis.
" tartras.
" bromidum.
" iodidum.
Morphiæ acetas.
" murias.
" sulphas.
Sodii bicarbonas.
" boras
" carbonas.
" chloridum.
" hypophosphis.
" sulphas.
" et pot. tartras.
" phosphas.
Acidum citricum.
" tartaricum.
" tannicum.

REQUIRING CERTAIN ADDITIONS TO FORM ELIGIBLE SOLUTIONS.

Quiniæ sulphas.
Cinchoniæ sulphas.
Quinidiæ sulphas.
Chinoidine.
Iodinium.
Hydrarg. iodid. rub.
Requiring viscid substances, as correctives or vehicles.
Ammonii carbonas.
Hydrargyri chloridi corros.
Plumbi acetas.
Potassii cyanuretum.
Potassa.

BEST FORMED INTO SOLUTION IN MAKING THE CHEMICAL COMPOUNDS.

Ammonii acetas.
Magnesii citras.
Acid. phosphoric.
Potassii arsenis.
" bitartras.
Arsenici et hyd. iod.
Potassa.
Ferri citras.
" nitras.
" phosphas.

INSOLUBLE.

MIXING WITH WATER, BUT NOT FORMING CLEAR SOLUTIONS.

Diffused by agitation:—
Magnesia.
Potassii bitart.
Sulphur præcip.
Pulv. cinchonæ.
" ipecac.
Calcis phosphas.
Quiniæ sulph.

Miscible by trituration alone:—
Extractum aconiti.
" belladonnæ.
" conii.
" hyoscyami.
" stramonii.
" taraxaci.
" krameriæ.
" glycyrrhizæ.
Confectiones.
Assafœtida.
Ammoniacum.
Guaiacum.
Myrrha.
Scammonium.

Suspended by the aid of viscid excipients:—
Copaiba.
Ol. amygdalæ.
Ol. ricini.
Ol. olivæ.
Olea essentia.
Ferri protocarb.

Best combined with a fixed oil or yelk of egg:—
Ext. Cannabis Indicæ.
Camphora.
Ol. terebinthinæ.
Chloroformum.

For preparations adapted to use as vehicles or correctives of the unpleasant taste, and other properties, especially of saline substances, see page 725.

Of the most numerous class in the syllabus, those which form eligible solutions without the addition of any chemical or other excipients, it should be remarked that many are so well adapted to combinations with other medical or corrective substances as to be rarely prescribed alone. Thus, muriate of ammonia is nearly always prescribed with expectorant remedies in cough mixtures. The bicarbonate and carbonate of potassium and of sodium with prophylactics, as in hooping-cough mixtures, or with stimulants, as in ordinary carminative and antacid remedies; acetate of potassium is much used with other diuretics. Alum and borax are best adapted to gargles and astringent washes, in which other medicines, not incompatible, may be combined. Bromide and iodide of potassium are instances of mineral substances, often combined with vegetable alteratives, which increase their effect and take off at the same time their very unpleasant sensible properties.

In the formulas which follow, these modes of combination are illustrated as well as those of the less soluble substances displayed in the other groups of the syllabus.

The part of this work devoted to pharmaceutical chemistry contains the mode of preparing those solutions, the medicinal ingredients of which are developed spontaneously in the process of preparation.

Chemical and Pharmaceutical Incompatibles.

The subject of incompatibles is, it appears to me, too much of a stumbling-block to the student. A moderate amount of chemical knowledge will serve to guard the practitioner against the use of incompatibles entirely, while the observance of a few simple rules will be sufficient to protect from glaring errors in this respect. In the list of substances incompatible with each other, as published in the older works, perhaps a majority are not likely to be ordered, on account of any fitness they have for each other in their therapeutical relations, while it is well known that some of the most popular of prescriptions are framed with the especial design of producing precipitates, which, being diffused in the resulting liquid, aid its general effect.

Authors have given too absolute a sense to the term incompatible, by giving sanction to the idea that all substances which form insoluble precipitates are incompatible with each other. An insoluble compound is not necessarily inert, but, as experience abundantly proves, is frequently the best and most eligible form for a medicine.

The reactions which occur in the organism are not to be judged of by ordinary chemical laws, as manifested in the laboratory of the chemist. The difference of action between the animal solvents under the influence of the life force, and those employed by the chemist with the mechanical means at his command, are too well known and appreciated to require extended notice. Living beings

can dissolve, appropriate, and circulate in their fluids, substances which, to ordinary agencies, are most intractable and insoluble.

Corrosive sublimate, when precipitated by albumen, gluten, and casein, is presented in the most insoluble form possible, and yet this mode of combination is highly recommended by the French as being more easily endured by the stomach, while the alterative effect is both mild and certain. This mode of procedure is stated by Dorvault to be adapted to a number of mineral salts, such as lead, tin, zinc, copper, silver, platinum, and gold, all of which form, with albuminous substances, compounds insoluble in water and ordinary solvents, but soluble in the liquids of the alimentary canal, by the aid of which they are placed in condition very suitable for medicinal action.

These facts are applicable to toxicology. When, in a case of poisoning from vegetable alkalies, tannin or an astringent decoction is given; or, after the use of a poisonous dose of arsenious acid, we give hydrated peroxide of iron; or, after corrosive sublimate, albumen; an insoluble compound is formed in each case, and yet it does not follow that these compounds are inert, but only that their immediate effects are destroyed, and their absorption diminished; indeed it has been proved that, in cases of poisoning, where antidotes had been used successfully, the urine contained both the poison and antidote five or six days after they were taken. The practice of administering purgatives and emetics for the complete evacuation of poisons, even after neutralization, is founded on the fact that they are still capable of slow absorption.

In connection with this subject, it may be well to mention the fact that when active metallic substances, as, for instance, the salts of mercury and of antimony, are taken for some time continuously, they seem to be deposited in the alimentary canal in an insoluble form, so that, by administering a chemical preparation which forms with them soluble salts, they sometimes display their activity to an alarming and even dangerous extent. The rationale of the use of iodide of potassium, after the long-continued use of mercurials, is, that it forms an iodide of mercury, which it dissolves and carries off through the secretions; salivation is sometimes induced, unexpectedly, in this way. It is stated that patients, who have used antimonials, are sometimes nauseated by lemonade made from tartaric acid, owing to the formation of tartar emetic from the undissolved oxide of antimony. These facts are not without interest, in connection with the subject of prescribing.

Considering it necessary, as a general rule, to avoid the association of substances which, by contact, may produce unknown or ill-defined compounds, or compounds different from those intended to be administered, I proceed to state briefly the most important rules relative to incompatibles:—

*Conditions resulting in Chemical Incompatibility.**

1. Whenever two salts in solution can, by the exchange of their bases and acids, form a soluble and an insoluble salt, or two insoluble salts, the decomposition takes place—the insoluble salt is precipitated, or, rarely, by combining with the soluble salt, gives birth to a double salt.

2. If we mix solutions of two salts which cannot create a soluble and an insoluble salt, a precipitate will not be formed, though often there will be decomposition.

3. In mixing any salt and a strong acid, a decomposition is very apt to take place; salts containing feeble acids, especially carbonic and acetic, are always decomposed by strong acids.

4. Alkalies in contact with the salts of the metals proper, or of the alkaloids, decompose them, precipitating their bases.

5. Metallic oxides, in contact with acids, combine with them and form salts the properties of which are sometimes unlike either the acid or the oxide.

6. Vegetable astringents precipitate albumen, gelatin, vegetable alkalies, and numerous metallic oxides, and with salts of iron produce inky solutions.

7. Glucosides, such as santonin and colocynthin, should not be prescribed with free acids or with emulsin.

8. The condition most favorable to chemical action is a solution of the salts in concentrated form without the intervention of viscid substances, so that when the indications require the employment of two substances which are incompatible, it is well to form a dilute solution of one of them in a mucilaginous or syrupy liquid before adding the other. In this way the decomposition may often be averted.

In the table appended, some preparations are mentioned which, as a general rule, the practitioner should avoid combining with other chemical substances; they are best given in simple solution, or some of them, with the addition of the Galenical preparations, or simple saccharine or mucilaginous excipients:—

Acidum hydrocyanicum.
" nitro-muriaticum.
Liquor hydrarg. et arsen. iod.
" potassii arsenitis.
" calcis.
" barii chloridi.
" calcii chloridi.
" iodinii compositus.
" potassæ.
" ferri citratis.
" ferri nitratis.
" morphiæ sulphatis.
Tinct. ferri chloridi.
Tinct. iodinii.
Antimonii et potassii tartras.
Potassii cyanidum.
" bromidum.
" iodidum.
" permanganas.
Ferri et pot. tartras.
Quiniæ sulphas.
Cinchoniæ sulphas.
Quinidiæ sulphas.
Morphiæ sulphas.
" murias.
" acetas.
" valerianas.
Zinci acetas.
Potassii acetas.

In addition to what has been said, it seems proper to notice what will be more particularly brought into view in commenting

* See all the 1st chapter on Inorganic Chemicals, page 109.

on the formulas which follow; the intentional use of medicines, in one sense incompatible, for the purpose of producing new and more desirable compounds. The proto-carbonate of iron is in this way produced from the sulphate and a carbonated alkali; the acetate of ammonium by the addition of acetic acid to a solution of the carbonate. In the same way black and yellow wash are extemporaneously prepared by adding to lime-water, calomel and corrosive sublimate, respectively. The association of sulphate of zinc and acetate of lead furnishes a familiar illustration of the same fact; the resulting precipitate of sulphate of lead, occurring as an impalpable powder or magma, is favorable to the therapeutic object in view.

Laudanum is quite incompatible with subacetate of lead; but one of the most popular of lotions contains these ingredients associated, so that it is not correct to say that these substances are incompatible in a medical sense, however, in a purely chemical point of view, they may be considered so.

Pharmaceutical incompatibles are those in which a disturbance of a solution takes place in a way not considered strictly chemical. Observation has satisfied me that these are very commonly associated, both in pills and liquid preparations. If we add tincture of Tolu to an aqueous solution, the resin of the Tolu separates almost entirely as a coagulum, and collects on the side of the bottle, thus being lost as a medicinal ingredient of the preparation, besides rendering it very unsightly. The same remark applies to tincture of myrrh added to solution of astringent salts, and to other resinous tinctures prescribed in connection with aqueous liquids.

On the admixture of tincture of guaiacum with the spirit of nitric ether, the resinous tincture gelatinizes into a mass, and is unfit for use. The addition of tincture of cinnamon to infusion of digitalis after filtration, as directed in the *Pharmacopœia*, occasions a precipitate.

List of Pharmaceutical Incompatibles.

Comp. infusion of cinchona, with comp. infusion gentian.
Essential oils with aqueous liquids in quantities exceeding one drop to f ʒj.
Fixed oils and copaiva, with aqueous liquids, except with excipients.
Spirit of nitric ether with strong mucilages.
Infusions generally with metallic salts.
Compound infusion of gentian with infusion of wild cherry.
Tinctures made with strong alcohol, with those made with weak alcohol.
Tinctures made with strong alcohol, with infusions and aqueous liquids.

Excipients used in Mixtures.

The consideration of excipients will bring into view the best modes of overcoming some pharmaceutical incompatibilities.

In the form of mixture the following liquids are used as diluents:—

Water.
The medicated waters.
Syrups.
Compound infusion of rose.
Emulsion of almonds.
Honey of rose.

As excipients or constituents in a stricter sense—

Powd. acacia, Sugar,	mixed or singly.	Many of the extracts.
Powd. tragacanth.		Yelk of egg.
Confections.		White of egg.

As flavoring agents with viscid ingredients as above—

Oil of caraway.	Tincture of Tolu.
Oil of cinnamon.	Tincture of ginger.
Oil of cloves.	Spirits of aniseed.
Oil of gaultheria.	Spirits of lemon.
Oil of sassafras.	Spirits of nutmeg.
Oil of bitter almond, etc.	Spirits of the mints.

As flavoring and coloring agents with or without viscid ingredients—

Tincture of cinnamon.	Comp. tincture of gentian.
Aniseed cordial.	Fluid extract of vanilla.
Tincture of cardamom.	Ginger syrup.
Compound tincture of cardamom.	Tolu syrup.
Compound spirit of lavender.	Curacoa cordial.
Tincture of fresh orange-peel.	Fruit syrups, etc.

The diluents are useful by enabling us to divide the doses of an active medicine to almost any extent; they correspond to the sugar, gum, aromatic powder, etc., prescribed for a similar purpose with powders, and with conserve of rose and other bulky additions used in pill masses.

The immense utility of excipients, and flavoring agents generally, will be best illustrated by the examples which follow. The skilful employment of these adds greatly to the success of the prescriber.

The necessity of limiting the assortment of prescriptions given, and the importance of including in them a considerable variety of medicinal agents, will forbid the illustration of all the numerous points in this connection, and much is necessarily left to the ingenuity of the learner.

Extemporaneous Solutions, Mixtures, etc.

Astringents.

No. 80.—*Mistura Cretæ*, U. S. P. (*Chalk Mixtures, or Chalk Julep.*)

Take of Prepared chalk	℥ss.
Sugar,	
Powdered gum Arabic, each	ʒij.
Cinnamon water,	
Water, each	f℥iv.

Rub them together until they are thoroughly mixed.

To this, which is a popular antacid astringent, the addition is often made of tincture of kino, or some similar vegetable astringent, either with or without tincture of opium. In the absence of cinnamon water, two drops of the oil of cinnamon for each ounce of that water ordered may be added to the dry ingredients. As the mixture does not keep very well, it is a convenient plan for the physician and pharmacist to keep the powders ready mixed, and

add the water when required. Chalk mixture is given in an adult dose of a tablespoonful.

No. 81.—*Blue Mass and Chalk Mixture.*

Take of Mercurial mass, in powder	ʒss.
Prepared chalk	ʒj.
Gum Arabic, in powder,	
Sugar, of each	ʒss.
Tincture of opium	♏xxx.
Aromatic syrup of rhubarb	fʒj, fʒvj.

Triturate into a uniform mixture.

Dose, fʒj to stimulate the secretion of bile and check diarrhœa. Tincture of kino or other astringents may be added. It should be shaken before being administered.

No. 82.—*Carbonate of Bismuth Mixture.*

Take of Carbonate of bismuth	ʒij.
Cinnamon water,	
Syrup of gum Arabic, each	fʒij.

Mix them.

Dose, a teaspoonful in *cholera infantum*, or for an adult fʒss.

No. 83.—*Parrish's Camphor Mixture.* (Dr. Parrish, Sen.)

Take of Aquæ camphoræ	fʒiij.
Spirit. lavandulæ compos.	fʒj.
Sacchari	ʒj.

Misce.

Give a tablespoonful every two hours in diarrhœa and cholera morbus, adding ten drops of laudanum where there is much pain.

This preparation, which was originally prescribed in 1832, has been found so generally useful and safe that it has become a standard remedy, and is prepared and sold by all druggists in Philadelphia, and prescribed extensively throughout the United States.

No. 84.—*Hope's Camphor Mixture.*

Take of Aquæ camphoræ	fʒiv.
Acidi nitrosi	♏xxx.
Tincturæ opii	♏xx.

Misce.

Dose, a tablespoonful every two hours in diarrhœa and dysentery.

This formula was originally made public, after twenty-six years' experience of its use in dysentery, by Thomas Hope, Esq., surgeon, Chatham, in the *Edinburgh Medical and Surgical Journal*, January, 1824. Dr. Hope was in the habit of directing *nitrous* acid, not nitric, which he says he has "not found to produce any good effect." I have been careful to follow his formula literally, and have for the purpose prepared nitrous acid by the process given on p. 155; though nitrous readily passes into nitric acid by contact with water, this reaction does not occur in presence of an excess of nitric acid. Few remedies have a more general and wide-spread reputation than this; it is now frequently prescribed, more than sixty years after its virtues were originally discovered.

Tonics.

No. 85.—*Fever and Ague Mixture.*

Take of Powdered red bark	ʒiij.
Confection of opium,	
Lemon-juice, each	ʒiss.
Port wine	fʒiij.

Mix by trituration in a mortar.

Dose, three tablespoonfuls morning, noon, and night, the day the fever is off.

Some recipes direct powdered serpentaria, ℈j, in addition to the above.

Though not an elegant, this is a most efficient and valuable combination.

No. 86.—*Solution of Acetate of Chinoidine.*

Take of Chinoidine	ʒj.
Acetic acid	fʒj.
Water	fʒxxix.

Make a solution.

Each fluidrachm contains about two grains of chinoidine, and serves as a dose.

This is a cheap form of cinchona preparation, used with success in the Moyamensing Dispensary, Philadelphia.

No. 87.—*Mistura Ferri Composita*, U. S. P. (Griffith's Myrrh Mixture.)

Take of Myrrh,	
Sugar, of each	ʒj.
Carbonate of potassium	gr. xxv.

Triturate together into a fine milky mixture with—

Rose water	fʒviiss.

Then add—

Spirit of lavender (simple)	fʒss.
Sulphate of iron, in coarse powder	℈j.

Pour the mixture immediately into a bottle, which must be well stopped.

Dose, a tablespoonful, as a tonic in phthisis, and in anæmic cases generally.

The strict phraseology of the *Pharmacopœia* has been departed from above in the hope of rendering the pharmaceutical points in the preparation more clear. The sulphate of iron and carbonate of potassium here used form by double decomposition sulphate of potassium and protocarbonate of iron, which latter floats in the milky mixture of myrrh and sugar, giving it a green color. This is in very small proportion, so that in each fʒss dose, there is not more than gr. ss. This preparation is, however, a very useful and elegant one. (*See* Pil. Ferri Carbonatis and Pil. Ferri Composita.)

No. 88.—*A good Preparation of Iron and Cinchona.*

(Substitute for Tinctura Cinchonæ Ferrata.—See p. 621.)

Take of	Tinct. cinchonæ comp.	f℥iv.
	Ferri citratis	ʒj.
	Acidi citrici	gr. xv.

Triturate the citric acid and citrate of iron together, and dissolve in the tincture of cinchona and quassia. Liq. ferri citratis f℥ij (see p. 233) may be used as a substitute for the rather insoluble dry salt.

The dose is a teaspoonful, containing two grains of citrate of iron.

The citric acid breaks up any tannate of iron as soon as formed, and although there is a liability to considerable precipitate of cinchonic red, and probably of the alkaloids, but very little iron is thrown down.

No. 89.—*A Concentrated Solution of Quinia and Iron.*

Take of	Quiniæ sulphatis	℈j.
	Tr. ferri chloridi	f℥iiss.

Ft. solutio.

One grain of sulphate of quinia is contained in every 7½ minims (about 15 drops) of the solution, which is an appropriate dose; it may be made with three times the proportion of quinia salt. To prescribe it in a more diluted form, add water f℥ij, and syrup of orange-peel (or other suitable flavor) f℥iij. The dose will then be a teaspoonful, equivalent to 1 gr. of the quinia salt.

Dr. Gilbert, of Philadelphia, informs me that he finds this a very useful remedy in cases of carbuncle, accompanied by an atonic condition and erysipelatous tendencies.

No. 90.—*A Bitter Tonic for Dyspepsia.*

Take of	Tinct. cinchonæ comp.	f℥iv.
	Tincturæ nucis vomicæ	f℥j.

Misce.

A teaspoonful three times a day in a little sugar and water.

This is one of the best combinations of its kind, though its effect should be carefully watched and its use omitted when symptoms of muscular contraction appear.

No. 91.—*A Tonic Cholagogue.*

Take of	Quiniæ sulphatis	ʒij.
	Extracti leptandræ	ʒj.
	Tinctura stillingiæ	f℥iv.
	Extracti podophylli	ʒiij.
	Olei sassafras,	
	Olei gaultheriæ, āā	gtt. x.
	Theriaci q. s. ut ft. f℥viij.	

Misce.

Dose, a teaspoonful three times a day.

This formula, by Dr. Mayes, of South Carolina, is said nearly to represent the celebrated Osgood's Cholagogue so extensively used in the Valley of the Mississippi and elsewhere.

No. 92.—*Mixture of Quinia, for children.*

Take of Quiniæ sulphatis, *pulv.* . . . . . ʒss.
Acaciæ pulveris . . . . . ʒss.
Syrupi zingiberis. . . . . fʒiv.

Ft. mistura.

Sig.—A teaspoonful, containing a grain of the quinia salt, three times a day.

The method of prescribing sulphate of quinia dissolved by the aid of aromatic sulphuric acid, develops its taste to the utmost, while, on the contrary, by suspending it in a very viscid liquid as above, the contact with the organs of taste is less perfect, and if followed immediately by a cracker or piece of bread the bitterness is not inconveniently experienced. When not contraindicated a few grains of tannic acid may be added to obtund the bitterness.

Arterial and Nervous Stimulants.

No. 93.—*Carbonate of Ammonium Mixture.*

		Each dose contains.
Take of Carbonate of ammonium.		gr. x.
Powdered gum Arabic		gr. x.
Sugar, each	ʒiss	gr. x.
Comp. spirit of ether		♏xv.
Comp. tinct. of cardam., each . . .	fʒij	♏xv.
Water	fʒiijss.	

Make a mixture.

Dose, a tablespoonful every two or three hours. A stimulant in low conditions, as in the last stages of disease.

No. 94.—*Oil of Turpentine Mixture.*

Take of Olei terebinthinæ . . . . . fʒiij.
Olei olivæ . . . . . fʒv.
Pulv. acaciæ,
Sacchari, āā . . . . . ʒij.
Tincturæ opii . . . . . ♏L.
Aquæ cinnamomi . . . . . fʒvss.

Mix the oil of turpentine with the olive oil, and triturate these with the gum and sugar, previously incorporated with a little cinnamon water, then dilute with the remainder of the cinnamon water, add the laudanum, and shake the vial till they are well mixed.

Oil of turpentine does not readily form an emulsion with gum and sugar unless mixed with some fixed oil, though the yelk of an egg may be successfully substituted for all other excipients. Dose of the above mixture fʒj (a teaspoonful) containing ♏iv of the oil of turpentine and ♏j of laudanum.

No. 95.—*Mistura Assafœtidæ*, U. S. P. (*Milk of Assafœtida.*)

Take of Assafœtida . . . . . ʒij.
Water . . . . . Oss.

Rub the assafœtida with the water gradually added until they are thoroughly mixed.

A good extemporaneous way to prepare this very popular antispasmodic, is to form a wine of assafœtida, as directed by Henry N. Rittenhouse, by triturating ℥ss of the gum resin with f℥x wine. The gum resin should be carefully selected, so as not to require straining; this wine will keep, and is converted into the mixture by adding to water in the proportion of ℥j (by weight) to each f℥j.

James T. Shinn, of this city, proposes the following mode of preparation, which, while it keeps well, enables the practitioner to double the strength of the mixture if desired, or by dilution to furnish it of the officinal strength.

Take of	Assafœtida	℥ss.
	Diluted acetic acid	f℥ij.
	Water	f℥iv.
	Sugar	℥iv.

Triturate together into a mixture. To make milk of assafœtida dilute with an equal portion of water.

Milk of assafœtida is much prescribed and extensively used as a domestic remedy. Dose, from f℥j to f℥ss.

No. 96.—*Chloroform Mixture, without Camphor.*

Take of	Chloroform,	
	Fixed oil of almonds, of each	2 fluidrachms.
	Powdered gum Arabic,	
	Sugar, of each	2 drachms.
	Orange-flower water	1 fluidounce.
	Water	2½ fluidounces.

Make a mucilage with the gum Arabic and sugar and about half a fluidounce of the water, then add the chloroform and almond oil, previously mixed together, triturate into a uniform milky liquid, and gradually dilute with the remainder of the water and the orange-flower water.

Dose, a teaspoonful, containing about ten drops of chloroform. The liability of chloroform to separate from mucilaginous excipients is, in this case, obviated by combining it with almond oil, which may be replaced by good olive oil, and furnishes an excellent mixture. (*See* Elixir Chloroformi, page 634.)

Syrupus amygdalæ furnishes one of the best vehicles for the administration of chloroform; f℥j of chloroform and f℥v or f℥vij of syrup when shaken together form an excellent mixture.

No. 97.—*Mistura Chloroformi*, U. S. P. (with Camphor).

Take of	Purified chloroform,	half a troyounce.
	Camphor,	sixty grains.
	The yelk of	one egg.
	Water,	six fluidounces.

Rub the yelk in a mortar first by itself, then with the camphor, previously dissolved in the chloroform, and lastly, with the water, gradually added, so as to make a uniform mixture.

This new officinal preparation contains about ten minims of chloroform and four grains of camphor to each tablespoonful, which would be the maximum dose.

No. 98.—*An Anodyne Mixture.* (Dr. Jos. Parrish, Sen.)

Take of Spt. ætheris comp.,
Spt. lavandulæ comp., āā . . . . . fʒj.
Spt. ammoniæ aromat. . . . . gtt. xl.
Liq. morphiæ sulphatis . . . . . fʒj.
Aquæ . . . . . fʒiij.
Sacchari . . . . . ʒij.

Misce.

Sig.—A small teaspoonful every hour until relieved.

This old recipe possesses unusual interest, from having been prescribed for a gentleman in Philadelphia who had it renewed at one establishment, at intervals, for nearly 30 years.

No. 99.—*Mixture of Cannabis Indica.*

Take of Ext. cannabis Ind. . . . . gr. xvj.
Olei olivæ . . . . . fʒj.

Ft. solutio et cum—

Acaciæ pulv.,
Sacchari, āā . . . . . ʒss.
Aquæ cinnamomi . . . . . fʒij.

Misce, secundum artem.

Dose, a teaspoonful, representing one grain of the extract.

Narcotics and Nervous Sedatives.

No. 100.—*Liquor Morphiæ Sulphatis*, U. S. P.

			Reduced.
Take of	Sulphate of morphia	gr. viij	gr. j.
	Distilled water	Oss	fʒj.

Dissolve the morphia in the distilled water.

This is an illustration of the most convenient method of giving small doses of soluble substances; here the proportions are so adjusted, that each teaspoonful shall represent $\frac{1}{8}$ gr. of morphia, which is a rather small dose.

A favorite prescription for after-pains in obstetric practice is a solution of sulphate of morphia in camphor water, in the same proportion as the above. Dose, the same.

Arterial and Nervous Sedatives.

No. 101.—*A Sedative, Diaphoretic Combination.*

			Each fʒj.
Take of	Vini antimonii		♏viij.
	Spt. ætheris nit., āā	fʒss	♏viij.
	Tinct. digitalis	fʒj	♏ij.
	Syr. acidi citrici	fʒiij.	

Misce.

Sig.—Take a teaspoonful every three or four hours.

No. 102.—*Remedy in Pulmonary and Catarrhal Diseases, etc., unattended by Fever.*

Take of	Acidi hydrocyanici	gtt. xl.
	Vini antimonii	f℥ss.
	Syrupi tolutani	f℥iss.
	Mucil. acaciæ	f℥ij.

M., fiat mistura, capiat cochl. parvum ter quarterve die.

This, with several similar combinations of hydrocyanic acid, is highly recommended by Dr. Horace Green, and published by him among his selections from favorite prescriptions collected from distinguished American physicians, in a scrap-book kept for the purpose. Rendered much more dilute, this is recommended as one of the best of remedies for hooping-cough.

No. 103.—*Creasote Mixture.*

Take of	Creasote	gtt. xvj.
	Powdered gum Arabic	℥j.
	Sugar	℥ss.
	Water	f℥ij.

Triturate the creasote with the gum and sugar, then gradually add the water and triturate to a uniform mixture.

Dose, a teaspoonful, containing one drop of creasote, used in bronchitis, phthisis, etc., and to check vomiting. Creasote is soluble in water to the extent of ♏v to f℥j, and for external use is best made into a suitable solution by shaking up with water.

No. 104.—*Aqua Creasoti*, U. S. P.

Take of Creasote, a fluidrachm.
Distilled water, a pint.

Mix them, and agitate the mixture until the creasote is dissolved.

CATHARTICS.

No. 105.—*Castor Oil Mixture.*

Take of	Gum Arabic, in powder,	
	Sugar, of each	℥iij.
	Oil of mint	gtt. iv.

Triturate into a uniform powder, and add water f℥vj, or sufficient to bring the mucilage to the consistence of castor oil, then add, by degrees, castor oil, f℥j, continuing the trituration till it combines into a perfect emulsion, with a uniform milky appearance; should this fail to appear, add a little more water, or, if the mucilage is evidently too dilute, a little more gum, care being taken to produce the uniform milkiness. Dilute this by adding water sufficient to make f℥iv.

This will make a perfect castor oil emulsion. If oil of turpentine is to be incorporated with it, let it be added to the mixed gum and sugar, before introducing the water and oil, or let it be first perfectly mixed with the castor oil. If laudanum, or some carminative and coloring adjuvant is desirable, it may be added at the

time of bottling. In no case should the oil be introduced into the bottle until combined with the other ingredients, as a portion will then adhere to the sides, and be imperfectly incorporated with the gum. Each tablespoonful of this mixture contains f℥j of oil, and may be given every hour till the desired effect is produced.

Several demulcent mixtures—as those of olive oil, almond oil, etc.—may be made upon this model. Copaiva mixture, introduced among the diuretics, may have a similar composition. The proportion of gum and sugar to the oily ingredient (℥iij each, to f℥j) should be remembered, as it applies equally to the other cases named.

No. 106.—*Extemporaneous Cream of Tartar Draught.*

Take of Tartaric acid	℥ix.
Water	f℥vj.

Make a solution and label No. 1.

Bicarb. potassium	℥vj.
Water	f℥vj.

Make solution, and label No. 2.

Mix from one to two tablespoonfuls of No. 1 with the same quantity of No. 2, and drink immediately.

In this way, the bitartrate of potassium is obtained in solution, although, if allowed to stand a few minutes, the liquid will deposit the salt in a white crystalline powder.

No. 107.—*A Charcoal and Blue Mass Mixture.*

Take of Carbo ligni	℥j.
Sodii bicarb.	℥ss.
Mass. pil. hydrarg.	gr. viij.
Syrupi rhei aromat.	f℥ij.
Aquæ	f℥ij.

Triturate together into a uniform mixture. Dose, a tablespoonful.

This was furnished by Dr. John D. Griscom, who finds it to meet a very common indication in general practice.

No. 108.—*A Magnesia Mixture for Children.*

Take of Magnesia (Husband's)	℥j.
Powd. gum Arabic	℥ss.

Triturate together, and add

Aromat. syrup of rhubarb	f℥iij.
Fennel water	f℥iss.

A teaspoonful is an appropriate dose.

To this mixture may be added, gr. xv of mercurial mass, which should be triturated with the powder, and, if required, the addition of say ♏viij of laudanum, or f℥j of paregoric. The precaution of shaking up before administering should not be overlooked.

Refrigerants and Antacids.

No. 109.—*Mistura Potassii Citratis.* (*Liquor Potassæ Citratis*, U.S.P. 1850. *Neutral Mixture, or Saline Draught.*)

Take of Lemon juice, fresh	Oss.
Bicarbonate of potassium	q. s.

Add the bicarbonate gradually to the lemon-juice till the acid is completely saturated, then strain through muslin.

No. 110.—*Liquor Potassæ Citratis*, U.S.P. 1860.

Take of Citric acid	℥ss.
Bicarbonate of potassium	ʒvss.
Water	Oss.

Dissolve the acid and bicarbonate in the water, and strain the solution through muslin.

In preparing Mistura potassii citratis, the use of fresh lemons is indispensable, and it is to provide for the occasional scarcity of these that the officinal Liquor potassii citratis is prescribed. Oil of lemon, which was formerly directed in this preparation, is now omitted, and this and sugar, when considered desirable, should be prescribed with the solution. Care must be taken in adding the bicarbonate to use a glass rod, porcelain spatula, silver spoon, or similar utensil, which will not corrode or impart a metallic taste to the preparation. It will also facilitate the operation of saturating the acid to triturate the crystals of bicarbonate in a dry mortar into a powder before adding it, little by little, to the liquid. The delay of filtering through paper may be very much obviated by using a fine muslin strainer, or by plugging the base of a glass funnel with some cotton, and pouring the liquid through it into the containing vial; it is an object to conduct this operation quickly, so as to retain and bottle up, as much as possible, the carbonic acid gas liberated in the reaction.

In making the solution both citric acid and the bicarbonate are directed to be weighed beforehand, and then the whole amount being added there will be no doubt as to the exact saturation of the acid: this is not practicable in the lemon-juice process, as there is no certainty as to its strength. In saturating lemon-juice it is well to cease adding the bicarbonate before it becomes perfectly saturated, or rather to err on the side of acidity than that of alkalinity. A slight excess of alkali may render the mixture quite disagreeable, while, on the other hand, the excess of acid should be extremely small. This subject may be concluded by presenting the following additional formulas for similar preparations:—

			Reduced.
No. 111.—Take of	Citrate of potassium	ʒvj	ʒiij.
	Water	Oss	f℥iv.
	Sugar	ʒss	gr. xv.
	Oil of lemon	♏j	gtt. j.

Make a solution.

Here there is no effervescence, and, consequently, no carbonic acid in the solution. In other respects it is the best recipe, because so

readily made. The sugar may be omitted or not, at pleasure, but seems to me to improve it. The substitution of carbonic acid water for common water is an improvement in making this preparation.

The following recipe is that of my friend, Ambrose Smith:—

No. 112.—*To make Effervescing Neutral Mixture Extemporaneously.*

		Reduced.
Take of Bicarbonate of potassium	ʒiij	ʒvj.
Citric acid	ʒij, ʒiij	ʒss, ϑij, gr. v.
Sugar	ʒiss	ʒiij.
Oil of lemon	gtt. xvj	♏iv.

Mix thoroughly and reduce to a uniform powder, and keep in a well-stopped bottle. To make neutral mixture, dissolve ʒvj, ϑj in Oss water (ʒiij, gr. x to fʒiv); this proportion, however, is somewhat less than the strength of the lemon-juice saturated with bicarbonate of potassium, and is considered an improvement, in view of the free and constant use of the preparation.

No. 113.—*Effervescing Draught.*

Take of Bicarbonate of potassium	ʒij, ϑij.
Water	fʒiv.

Make a solution.

Directions.—Take a tablespoonful of lemon-juice diluted with a tablespoonful of water, and add to it in a tumbler a tablespoonful of this solution, then drink immediately.

No. 114.—*Effervescing Draught without Lemon-juice.*

Take of Bicarbonate of potassium	ʒij, ϑij.
Sugar	ʒj.
Water	fʒiv.

Make a solution and label No. 1, the alkaline solution.

Take of Citric acid	ʒij.
Oil of lemon	♏j.
Water	fʒiv.

Make a solution and label No. 2, the acid solution.

Directions.—To a tablespoonful of No. 1, add a tablespoonful of water, and to the mixture, in a clean tumbler, add a tablespoonful of No. 2; drink immediately.

No. 115.—*Effervescing Fever Powders.*

Take of Citric acid, dried and powdered . . . . . ʒv.

Divide into twelve parts, wrapped in white writing paper.

Take of Bicarbonate of potassium, dried and powdered . ʒviss.

Divide into twelve parts, wrapped in blue paper.

Inclose these white and blue powders alternately in a tin box.

In drying the bicarbonate the temperature should never rise above 120° F.

Directions.—Dissolve the contents of a white paper in a tumbler, one-third full of cold water, then stir in the contents of a blue paper, and drink immediately.

A dose is usually given every two or three hours during the prevalence of the fever.

The various forms of citrate of potassium, which are now described, constitute favorite remedies in fever; sometimes spirit of nitric ether, tartar emetic, tincture of digitalis, tincture of veratrum viride, or other remedies are added to them.

The effervescing draught is said to be the best way to give alterative or sedative doses of tartar emetic when the stomach is irritable.

No. 116.—*Liquid Substitute for Dover's Powder.*

Take of Vin. ipecac.	♏xvj.
Tinct. opii	♏xiij.
Spirit. ætheris nit.	f℥j.

Misce.

Sig.—Take at one dose diluted with water at going to bed.

ANTACIDS.

No. 117.—*A Mild Antacid for Young Infants.* (*Soda Mint.*)

Take of Sodii bicarb.	℥ss.
Aquæ menthæ	f℥iv.

Ft. solutio.

Prescribed by Dr. Meigs and others. DOSE, a teaspoonful, as an innocent substitute for the numerous carminatives.

No. 118.—*Aromatic and Antacid Corrective of Indigestion.*

Take of Sodii bicarbonatis	℈iv.
Infus. gentianæ comp.	f℥iiss.
Aquæ menthæ pip.	f℥iij.
Tinct. cardamomi comp.	f℥ss.

Misce.

DOSE, a tablespoonful as required.

The above makes a handsome preparation; it was furnished me by my friend Dr. J. J. Levick.

No. 119.—*Carbonated Soda Powders.*

For making a draught of soda water extemporaneously.

Take of Bicarbonate of sodium	gr. xxiij.	Fold in a blue paper.
Tartaric acid	gr. xx.	Fold in a white paper.

Directions for use.—Dissolve the powders contained in the white and blue papers in separate tumblers, each nearly half full of water, then mix their contents and drink immediately. A little syrup may be added to one or both of the glasses before mixing. These are usually put into boxes containing twelve of each kind of powders. (*See* Seidlitz Powders, p. 552.)

Yeast Powders.

A substitute for yeast in making batter cakes, having the advantage of making the batter perfectly light and ready for baking without delay, and greatly diminishing the liability to become sour. Many dyspeptics, who cannot tolerate fresh light cakes when made with yeast, can eat them with impunity when raised in this way.

Fold in a blue paper, Bicarbonate of sodium	120 grs.
Fold in a white paper, Tartaric acid	100 grs.

Directions for use.—Put the contents of a white and blue paper into separate teacups filled with water, and stir until perfectly dissolved. Mix a sufficient quantity of batter for six or eight persons a little thicker than usual, to allow for the liquid in which the powders are dissolved; and when ready for baking stir in well the contents of one teacup, then add the other and stir it well, and commence baking immediately.

A more economical way, and sufficiently accurate in view of the harmlessness of the ingredients, is to keep supplies of the bicarbonate of sodium and tartaric acid in separate bottles, which will insure their perfect dryness, and then when wanted for use take a small teaspoonful of each, and dissolve as above. The equivalent weights of these ingredients have very nearly the same bulk. If bitartrate of potassium is substituted for tartaric acid, it must be used in about twice the quantity, and being insoluble, must be suspended in water and thoroughly stirred in.

Demulcents and Diuretics.

No. 120.—*Mistura Amygdalæ*, U. S. P. (*Emulsion of Almonds.*)

Take of Sweet almonds, half a troyounce	℥ss.
Gum Arabic, in fine powder, thirty grains . . .	ʒss.
Sugar, one hundred and twenty grains	ʒij.
Distilled water, eight fluidounces	f℥viij.

Having blanched the almond, beat it with the gum Arabic and sugar, in a mortar, until they are thoroughly mixed, then rub the mixture with distilled water, gradually added, and strain.

The almonds may be conveniently blanched by soaking them in warm water until the skin is softened, and then separating the kernels by rubbing them between two cloths or pressing each between the thumb and forefinger. This elegant emulsion is often varied by the use of one-fourth the quantity of bitter almonds. By diluting the officinal syrup of almonds a substitute is obtained. It is a very bland and nutritious demulcent, taken *ad libitum* or used as a vehicle for other medicines. As a demulcent nutrient in pulmonary consumption, it has been found a useful domestic remedy.

No. 121.—*Emulsion of Fluid Extract of Cubebs.*

Take of Oleoresin of cubebs	120 drops.
Yelk of egg	one.
Sugar, powdered	2 drachms.
Mint water	sufficient to make three fluidounces.

Triturate the fluid extract with the powdered sugar and yelk of egg, and then dilute with the water. Direct a teaspoonful four times a day.

This may be made by substituting ʒij powdered gum Arabic and ʒj sugar for the yelk of egg. It is a fine stimulant to the mucous surfaces, adapted to catarrhs, etc., as well as to urinary diseases. The dose is fʒj, containing gtt. v. of the oleoresin of cubebs.

Taraxacum Mixtures.

These useful cholagogue and laxative preparations may be made by the addition of fluid extract of taraxacum to any other ingredients desirable to incorporate with it, either for the purpose of increasing its action on the bowels, on the liver, or on the kidneys, as the case may require. The solid extract is also adapted to being incorporated in mixtures by trituration with about four times its weight of water.

No. 122.—*Alkaline Copaiva Mixture.*

Take of Copaibæ,
Liq. potassæ, āā . . . . . fʒij.
Pulv. acaciæ,
Pulv. sacchari, āā . . . . . ʒij.
Aq. menth. virid. . . . q. s. ut fiat fʒiv.

Mix the copaiva and solution of potassa, add the water, and triturate with the gum and sugar.

In this prescription, which is prescribed by my friend, Dr. William Hunt, the copaiva is combined into a soap with the alkali, and would be perfectly suspended without the aid of gum and sugar, which are added to obtund the acrid taste. Of coarse, oil of cubebs, tincture of opium, and other adjuvants, may be added if required. The usual method of suspending copaiva is similar to that given in Prescription No. 105. The dose is a tablespoonful, containing ♏xv of copaiva.

No. 123.—*Extemporaneous Solution of Acetate of Potassium.*

Take of Acetic acid . . . . . fʒvj.
Water . . . . . fʒiij.
Bicarb. potassium . . . . . ʒiijss, or sufficient to form a neutral solution.

This is designed to obviate the necessity of weighing the very deliquescent acetate of potassium, and will contain, to each fʒj, about ten grains of the salt, which is an appropriate dose. The admixture of fluid extract of taraxacum, or of buchu, or of spirit of nitric ether, or comp. spirit of juniper, will be appropriate in certain cases.

No. 124.—*Benzoated Alkaline Mixture.*

Take of Potassii bicarbonat. . . . . ʒiij.
Acid. benzoic. . . . . ʒj.
Aquæ . . . . . fʒv.
Syr. aurant. . . . . fʒj.
Misce.

Sig.—One tablespoonful three times a day, after meals. Prescribed by Dr. Ellwood Wilson in torpid conditions of the kidneys and albuminuria.

No. 125.—*Scudamore's Mixture for Gout.*

Take of	Sulphate of magnesium	℥j.
	Mint water	f℥x.
	Vinegar of colchicum	f℥j.
	Syrup of saffron	f℥j.
	Magnesia	℥ij, ℈ij.

Mix.

Dose, one to three tablespoonfuls every two hours till four to six evacuations are procured in the twenty-four hours.

This recipe is often varied by the substitution of a less proportion of the wine of colchicum for the vinegar, the omission of the syrup of saffron, etc. The above is, I believe, the original prescription.

No. 126.—*Dewees' Colchicum Mixture.*

Take of	Wine of colchicum seed	gtt. xxx.
	Denarcotized laudanum	gtt. xxv.
	Sugar	gr. xxx.
	Water	f℥j.

Mix.

To be taken at night in one draft.

No. 127.—*Dr. Atlee's Prescription for Neuralgic and Rheumatic Symptoms.*

Take of	Ethereal tincture of guaiacum	f℥j.
	Ethereal tincture of colchicum	f℥vj.
	Ethereal tincture of cannabis Ind.	f℥ij.

Mix.

Dose, twenty-five to thirty drops every four hours, on sugar.

Expectorants, etc.

No. 128.—*Mistura Ammoniaci*, U. S. P. (*Lac Ammoniac.*)

Take of	Ammoniac	℥ij.
	Water	Oss.

Rub the ammoniac with the water, gradually added, until they are thoroughly mixed.

Dose, a tablespoonful as a stimulating expectorant.

No. 129.—*Mistura Glycyrrhizæ Composita*, U. S. P. (*Brown Mixture.*)

			Reduced.
Take of	Liquorice, in fine powder,		
	Gum Arabic, in fine powder,		
	Sugar, in coarse powder, each	℥ss	℥j.
	Camph. tincture of opium	f℥ij	f℥ss.
	Wine of antimony	f℥j	f℥ij.
	Spirit of nitrous ether	f℥ss	f℥j.
	Water	f℥xij	f℥iij.

Rub the liquorice, gum Arabic, and sugar with the water gradually added; then add the other ingredients, and mix the whole together.

The dose of this very popular cough medicine is a tablespoonful, or for children f℥j.

No. 130.—*A Coryza Mixture of Cubebs, etc.*

Take of Oleoresin of cubeb . . . . . f℥j.
Sulphate of morphia . . . . . gr. iss.
Syrup of senega,
Syrup of wild-cherry, of each . . . . . f℥ij.

Mix.

Dose, a teaspoonful occasionally. Cubeb, by its excellent effects upon the mucous surfaces, is well adapted to the treatment of chronic coughs, coryza, and sore throat.

No. 131.—*A Balsamic Expectorant Mixture.*

Take of Syrupi tolutani,
Syrupi ipecacuanhæ, āā . . . . . f℥j.
Pulv. acaciæ . . . . . ℥j.
Tinct. opii camph.,
Tinct. lobeliæ, āā . . . . . f℥iij.
Aquæ . . . . . f℥j.

Triturate the gum and water together, and add the other ingredients in the vial. Dose, a teaspoonful.

This was furnished by Dr. S. W. Butler, of Philadelphia Hospital, Blockley, who has prescribed it with satisfaction.

No. 132.—*Tolu Cough Mixture.*

Take of Syr. scillæ . . . . . f℥j.
Fulv. acaciæ,
Sacchari, āā . . . . . ℥iij.
Aquæ . . . . . f℥vj.
Tinct. tolutanæ . . . . . f℥ij.

Misce secundum artem. Dose, f℥j.

No. 133.—*Mixture of Acetone, Tar, etc.*

Take of Acetone . . . . . f℥j.
Camph. tinct. of opium,
Antimonial wine, of each . . . . . f℥j.
Wine of tar (Jew's beer) . . . . . f℥ij.

Mix. Dose, a teaspoonful.

Prescribed in asthma by Dr. Washington L. Atlee.

No. 134.—*Spermaceti Mixture.*

Take of Spermaceti . . . . . ℥ij.
Olive oil . . . . . f℥j.
Powd. gum Arabic . . . . . ℥ss.
Water . . . . . f℥iv.

Triturate the spermaceti with the oil, until reduced to a paste, then add the gum, and lastly the water gradually. Dose, f℥j.

No. 135.—*Cochineal Hooping-Cough Mixture.*

Take of	Carbonate of potassium	℈j.
	Powdered cochineal	℈ss.
	Sugar	ʒj.
	Water	fʒiv.

Make a mixture. Dose for children, fʒj, every two or three hours. An old and very popular remedy.

No. 136.—*For Hooping-Cough.* (By Golding Bird.)

Take of	Aluminis	gr. xxiv.
	Ext. conii	gr. xij.
	Aq. anethi (vel fœniculi)	fʒiij.
	Syrupi papaveris	fʒij.—M.

Sig.—For an adult, a dessertspoonful every six hours.

The use of simple tincture of belladonna in doses of from 1 to 5 drops, three times a day, is useful in most cases of hooping-cough.

Fixed Oils.

The taste of fixed oils may be best destroyed by adding a few drops of oil of bitter almonds to a pint of the oil, though this will not remove rancidity, which when present is the greatest obstacle to their being acceptable.

The mode of administering the fixed oils may here claim attention; by observing to prevent their contact with the mouth in swallowing, the chief objection to them is obviated. This may be variously accomplished by enveloping them in the froth of fermented liquors, or by pouring them into a glass partially filled with iced water, or an aromatized water, so that no portion of the oil shall touch or adhere to the sides of the glass. When carbonic acid water is convenient, it furnishes, with sarsaparilla syrup, one of the best vehicles for castor or cod-liver oil; there should be but little water drawn, but it should be thrown up as much as possible into froth.

There is no doubt that oil mixtures, though less conveniently taken, are more rapid and more active in their effects than the oils themselves, and the following, with the castor oil and copaiva mixtures, Nos. 105 and 122, will illustrate their best modes of preparation.

No. 137.—*Mixture of Cod-liver Oil.*

Take of Cod-liver oil, six fluidounces.
Lime-water, nine fluidounces.

To the lime-water, in a pint bottle, add the oil, and shake them; flavoring ingredients may be added at pleasure.

No. 138.—*Mistura Olei Morrhuæ Amara.* (St. Mary's Hospital.)

			To one ounce.
Take of	Cod-liver oil	fʒj.	1 drachm.
	Powdered gum Arabic	ʒij, ℈ij	1 scruple.
	Spirit of peppermint	fʒj	5 minims.
	Infusion of quassia	fʒvij	7 drachms.

Make an emulsion as directed in the case of castor oil mixture, p. 841; dilute, and add the other ingredients.

No. 139.—*Mistura Olei Amygdalæ.* (London Consumption Hospital.)

		In one ounce.
Take of Oil of almonds	f℥j	1 drachm.
Solution of potassa	♏xl	5 minims.
Water	f℥vij	7 drachms.

Combine the alkaline solution with the oil, and dilute.

Olive oil may be substituted in this formula, and neat's foot oil with a slight increase in the proportion of solution of potassa. A medicated water, as mint or bitter-almond water, may be used, in part or entirely superseding water.

No. 140.—*Mistura Olei Cocos Nucis.* (London Consumption Hospital.)

		Reduced.
Take of Cocoanut oil	℥j, ℥vj	100 grains.
Spirit of ammonia	f℥iij	20 minim.
Water	f℥vj	6 drachms.

Mix.

Alteratives.

Alterative preparations are often made by the addition of the various iodine, mercurial, and other alterative salts, to the Galenical preparations of sarsaparilla, conium, etc. As a general rule, these salts are incompatible with each other; those which are insoluble are conveniently prescribed with iodide of potassium, which is, in fact, one of their natural associated solvents. (*See* Syrups.)

No. 141.—*Cod-liver Oil and Red Iodide of Mercury.*

Take of Red iodide of mercury	gr. viij.
Cod-liver oil	Oj.

Triturate together.

This forms a clear solution, and each tablespoonful dose contains ¼ gr. of the red iodide of mercury; it is a combination occasionally indicated. Iodine itself is sometimes given in the oil, and from ¼ to ⅛ gr. to f℥j makes a good addition in certain cases.

Anthelmintics.

No. 142.—*Anthelmintic Syrup.**

Take of Syrup of rhubarb	f℥iv.
Fluid extract of senna	f℥ij.
Oil of chenopodium	f℥ij.

Mix them.

Dose, a teaspoonful three times a day.

* See also Prescription No. 94, Oil Turpentine.

No. 143.—*Emulsion of Pumpkin Seeds.*

Take of Pumpkin-seeds, fresh	℥viij.
Sugar	℥ij.
Gum Arabic, in powder	℥ss.
Water	Oj.

Blanch the seeds, beat them into a mass with the sugar, then add the gum Arabic, and gradually the water.

Dose, a pint in the course of the day, for *tapeworm.*

The use of the seeds of *Cucurbita pepo* (pumpkin) in tapeworm originated in the United States. I believe the first account of their properties was published by Dr. Jones, of Boston; their use has now extended to Europe and to Algeria, where they have been recently reported on favorably by M. Tarneau, a military surgeon. The form of electuary is perhaps better than the emulsion prescribed above. It is directed to be made by depriving ten drachms of the seed of their husks, pounding them in a mortar with sufficient sugar into a paste, and adding to this a small cup of milk; to be taken at one dose, following with a dose of castor oil in two hours.

Jellies.

Jellies made of fixed oils have the advantage of diminishing the adhesion of these to the mouth, which is their most disagreeable property. Cod-liver oil and castor-oil jellies, as patented by Queru, of New York, enjoy a large sale, and are much prescribed by physicians. Without interfering with this patent, the physician may prescribe jellies of any of the fixed oils or of copaiva by the following recipe, contrived with the aid of my colleague, Wm. C. Bakes:—

Take of The fixed oil, an ounce.
Honey and syrup, of each, half a fluidounce.
Powd. gum Arabic, two drachms.
Russian isinglass, forty grains.
Orange-flower water, six fluidrachms.

Dissolve the isinglass, by the aid of heat, in half an ounce of the orange-flower water, replacing the water as it evaporates, triturate the other ingredients with the remainder of the orange-flower water into a homogeneous mass, in a warmed mortar, then form an emulsion by adding the solution of isinglass, stir as it cools, and set aside to gelatinize.

The orange-flower water may soon become distasteful, and should then be replaced by other flavors, of which bitter almond most completely disguises the fishy taste of cod-liver oil.

CHAPTER V.

STYPTIC AND DEPILATORY POWDERS, LOTIONS, COLLYRIA, INJECTIONS, ENEMAS, GARGLES, BATHS, INHALATIONS, AND FUMIGATIONS.

Styptic Powders.

The persulphate of iron (Monsell's salt), described under the head of Preparations of Iron, is perhaps best adapted to arresting hemorrhage. The following may be instanced as a combination suited to the same purpose.

Take of Resinæ pulv.,
Aluminæ exsiccat.,
Acaciæ pulveris, āā, partes æquales.

M. et in pulv. trit.

Causticum Depilatorium. (London Skin Hospital.)

Take of Orpiment	ʒj.
Quicklime	ʒiss.
Starch	ʒix.

Mix and triturate together into a fine powder.

Lotions.

Soluble salts, chiefly of the astringent class, dissolved in distilled water, or in distilled rose-water, designed for external application, constitute *lotions*, or washes; these are to be applied to the surface, usually upon a folded piece of muslin or lint, chiefly for cooling and astringent purposes. Lead-water (page 274) is the only officinal lotion. Vinegar and water, or water alone, is applied for the same purposes. In various chronic skin diseases, lotions containing sulphuret of potassium, chloride of zinc, corrosive chloride of mercury; borax, solution of chlorinated soda, and other chemical agents, are employed. Glycerin, by its solubility in water, and its emollient properties, is well adapted to this form of application. The recipes appended are selected as illustrations of this class; they are generally well-known preparations.

No. 144.—*Creasote Lotion.*

Take of Creasoti	gtt. x.
Aceti	fʒij.
Aquæ	fʒij.

Misce.

Applied to phagedenic ulceration, chancres, and a variety of sores.

No. 145.—*Yellow Wash.* (*Aqua Phagedænica.*)

Take of Hydrargyri chloridi corrosivi . . . . . gr. xvj.
Liquoris calcis . . . . . f℥viij.
Misce.

The binoxide of mercury is precipitated as a yellow powder, and diffused through the liquid; sometimes the proportion is diminished to gr. j in each f℥j. It is a very popular application to certain affections and to venereal sores.

No. 146.—*Black Wash.*

Take of Hydrargyri chloridi mitis . . . . . ℥j.
Liquoris calcis . . . . . f℥iv.
Misce.

Protoxide of mercury is here thrown down by the lime as a black precipitate, though there is quite an excess of calomel. It has similar applications to the foregoing.

Granville's Counter-irritant or Antidynous Lotions.

No. 147.—The mild:—

Take of Liquoris ammoniæ fortioris . . . . . f℥j.
Spiriti rosmarini . . . . . f℥vj.
Tincturæ camphoræ . . . . . f℥ij.
Misce.

No. 148.—The strong:—

Take of Liquoris ammoniæ fortioris . . . . . f℥x.
Spiriti rosmarini . . . . . f℥iv.
Tincturæ camphoræ . . . . . f℥ij.
Misce.

These preparations will blister in periods varied from two to ten minutes, by saturating with them a piece of linen folded five or six times over a coin, and pressing it upon the part. Over more extended surfaces, a similar method is adopted by protecting the lotion from evaporation.

No. 149.—*Lotion for Chilblains.*

Take of Muriate of ammonium . . . . . ℥ss.
Water . . . . . f℥iv.
Muriatic acid . . . . . f℥j.
Alcohol . . . . . f℥iss.

Apply morning and evening.

No. 150.—*Dr. Thomas's Nipple Wash.*

Take of Alum . . . . . ℥j.
Tincture of galls . . . . . f℥j.

Triturate together until as nearly dissolved as possible.

No. 151.—*Clemens' Almond Lotion.*

Take of Gum senegal . . . . . ℥iv.
Boiling water . . . . . Cong. j.

Strain, and when cold add—

Tinct. benzoin	f℥ij.
Alcohol	f℥ij.
Corrosive chloride of mercury	℥j, ℈j.

Dissolve the corrosive chloride in the alcohol, before mixing with the other ingredients.

No. 152.—*Milk of Roses for Chapped Hands.*

Take of Almonds, blanched	℥j.

Beat to a paste, and mix with—

Rose-water	f℥vj.

Heat to about 212° F., and incorporate with—

White wax	℥j.
Almond oil	℥ij.
White Castile soap	℥j.

Melt together and thoroughly incorporate, then add—

Honey water	f℥ij.
Cologne water	f℥j.
Oil of bitter almond	gtt. iv.
Oil of rose geranium	gtt. v.
Glycerin	f℥ss.

After washing the hands with warm water and Castile or other mild soap, apply the milk of roses, and rub it thoroughly in, then wipe them with a dry towel.

Milk of roses is adapted to being put up in rather wide-mouth vials, and is directed to be applied to chapped hands, or other excoriated parts.

COLLYRIA.

Collyria are lotions or applications to the eye, called eye-washes. They are generally composed of astringent salts, as sulphate or acetate of zinc, sulphate of copper, or of iron or nitrate of silver, the proportion seldom exceeding gr. viij to f℥j.

No. 153.—*Thomas's Eye Water.*

Take of Sulphate of zinc, Chloride of sodium, each	℈j.
Rose water (distilled)	f℥j.

Make a solution, and apply, suitably diluted, to inflamed eyes.

The infusion of sassafras-pith is a good addition to this and similar eye-washes. The aqueous extract, or the wine of opium, is much used in collyria.

No. 154.—*Collyrium Atropiæ Sulphatis.* (Guy's Hospital.)

Take of Atropiæ sulphatis	gr. iij.
Aquæ	f℥j.

Ft. solut.

A substitute for solutions of extract of belladonna for dilating the pupil.

Injections.

Injections are solutions intended to be thrown into the external ear, the urethra, bladder, vagina, etc. They resemble the foregoing class in composition and in strength. In gonorrhœa, the use of injections of the astringent metallic salts is very common, as also of vegetable astringents.

No. 155.—*Injectio Argenti Nitratis.* (Westminster Hospital.)

Take of Nitrate of silver, six grains.
Diluted nitric acid, five minims.
Distilled water, four ounces.

Make a solution.

No. 156.—*Campbell's Injection for Gonorrhœa.*

Take of	Zinci sulph.	ʒss.
	Plumbi acet.	ʒj.
	Tinct. opii,	
	Tinct. catechu, āā	fʒij.
	Aquæ rosæ	fʒvj.

Misce.

This is an instance in which chemical incompatibles are mixed advisedly so as to produce a very fine precipitate, which, being diffused in the liquid and deposited on the mucous membrane of the urethra, favors the therapeutic effect intended.

No. 157.—Take of Sulpho-carbolate of zinc . . . . . gr. vj.*
Water . . . . . fʒij.

Dissolve, for injection in gonorrhœa.

An improved form of glass penis syringe has an enlargement of the tube, which enters the urethra, at the extreme end, so as to fill the whole diameter of the tube and prevent the backward flow of the liquid, while the rounded end is less liable to produce irritation than a more pointed termination.

Enemata.

The custom of injecting tepid water and various bland and medicinal liquids into the rectum, for the relief of costiveness, has become very common of latter years, and the forms of apparatus contrived are numerous and ingenious, constituting a considerable article of trade with druggists and apothecaries.

The forms of self-injection apparatus made by Davidson, Mattson, and others, consisting of a gum-elastic bag designed to be grasped in the hand, and, by alternate contraction and expansion, to draw the fluid from a basin and throw it through a flexible tube and

* Sulpho-carbolate of zinc may be prepared by saturating with carbonate of zinc free from iron sulpho-carbolic acid, made by melting one troyounce of Calvert's pure crystallized carbolic acid with one troyounce of sulphuric acid (sp. gr. 1.84) gradually added, heating to 280° F., and adding three fluidounces of distilled water after permitting the mixture to stand 12 hours. The solution is then filtered, evaporated at 150° F., and set aside to crystallize. For a full account of the various salts of this acid and their modes of preparation, see *Amer. Journ. Pharm.*, 1870, 133, 1871, 10, 265.

metallic injection-pipe into the rectum or vagina, has almost superseded the old kind which worked with a piston. A French pattern, however, which consists of a cylinder and piston working by a spring, designed to be wound up to its utmost tension, and then, on the opening of a faucet, to throw the whole contents in a continuous stream through the flexible tube and pipe, is preferable to any other in use, but has two objections: first, for a person who has but little strength of wrist, it is very difficult to wind it up; secondly, the expense is very much greater than the best Mattson syringe. The only valve in this instrument is in the piston, and is so simple and durable as to remove one of the most common objections to cylinder injection apparatus.

Medicated enemata are much used for the relief of painful flatulence and for relaxing spasm. The following are adapted to this object:—

No. 158.—*Enema Terebinthinæ.*

Take of	Oil of turpentine	f℥ss.
	Castor oil	f℥j.
	Gum Arabic	℥ss.
	Water	Oss.

Make an emulsion, *secundum artem.*

In the above the white of an egg may be substituted for the gum with advantage.

No. 159.—*Enema Assafœtidæ.* (St. Bartholomew's Hospital.)

Take of Tincture of assafœtida, half a fluidounce.
Decoction of barley, one pint.

Mix.

Gargles.

Gargles and *Mouth-washes* are applications much used in the treatment of so-called sore-throat, and in scorbutic affections of the gums, which are exceedingly common; these are popularly treated by counter-irritation, and by the use of astringent and stimulating gargles. Infusions of capsicum, of vegetable astringents, and of sage, with the addition of alum, borax, or sulphate of zinc, and almost invariably honey, are the prevailing remedies of this class. The following recipes may be given:—

No. 160.—*Gargarysma Sodæ Chlorinatæ.*

Take of	Solution of chlorinated soda	f℥ss.
	Water	f℥iij.

Mix.

No. 161.—*Gargarysma Acidi Tannici.* (London Consumption Hospital.)

Take of	Tannic acid	1 drm.
	Honey	2 drms.
	Water	4 ounces.

Mix.

No. 162.—*Gargle and Mouth-Wash.*

Take of Sodii boratis . . . . . ℥j.
Aquæ rosæ . . . . . f℥ij.
Mellis . . . . . f℥j.

Misce, et adde—

Tincturæ myrrhæ . . . . . f℥ss.
Tincturæ capsici . . . . . f℥ij.

Sig.—Use as a gargle every two or three hours, diluted with water.

No. 163.—*Gargle of Alum.*

Take of Aluminis . . . . . ℥ss.
Infusi lini . . . . . Oss.
Mellis . . . . . q. s.

Fiat gargarysma.

Baths.

Baths are either hot, warm, tepid, or cold, or consist in the application of vapor merely. They are variously medicated for the treatment of diseases of the skin, and for producing general or local revulsive effects.

The production of artificial sea-water is a desideratum for bathing, and may be accomplished either by the evaporation of sea-water to a granular powder, to be dissolved in water as occasion requires, or approximately by the use of the following formula:—

No. 164.—*Artificial Sea-Water.* (*Balneum Marinum.*)

Take of Chloride of sodium, two pounds.
Chloride of calcium, three ounces.
Chloride of magnesium, one and a half ounce.
Sulphate of magnesium, three ounces.
Sulphate of sodium, six ounces.
Iodide of potassium, one drachm.

Mix, and dissolve in 30 gallons of water, for a single bath.

No. 165.—*Iodine Bath.* (*Balneum Iodinii.*)

Take of Iodine, two drachms.
Solution of potassa, two ounces.
Water, thirty gallons.

Used in the Skin Hospital, of London.

Inhalations, Fumigations, Disinfectants, etc.

Inhalation has lately been a good deal resorted to as a remedy in chronic catarrhs, bronchitis, incipient phthisis, etc. I have repeatedly prepared the apparatus and furnished the ingredients for the following:—

No. 166.—*Prescription for Inhalation.*

Into an inhaler of glass put infusum humuli, U. S., f℥iv, at a temperature of about 120° F., and add Liq. iodinii compositus,

mxx. Inhale from five to ten minutes, morning and evening. In acute cases, this is found to give great relief, and by continued application produces most happy restorative effects. In place of Lugol's solution, it has been suggested to use an ethereal or chloroformic tincture of iodine, adding a little iodide of potassium to prevent precipitation on adding it to the hop-tea, or other aqueous liquid.

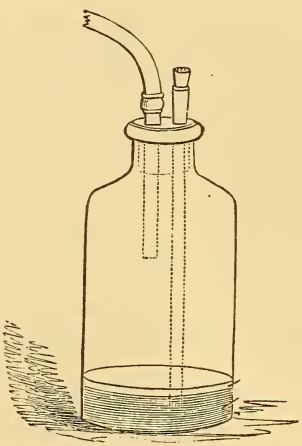
In the London Consumption Hospital the following formula is used:—

No. 167.—Take of Chloric ether . . . . . 30 minims.
Tincture of hyoscyamus . . . . . 30 minims.
Infusion of hops (or water) . . . . 8 ounces.

Mix, and inhale.

In several cases under my observation the use of powdered cubebs, a teaspoonful to each charge of warm water, a fresh portion being added each time, inhaled three times every day, has had an excellent effect in treating bronchial affections.

Fig. 246.



Inhaler.

Fig. 246 exhibits a simple form of inhaling apparatus. An ordinary wide-mouth packing bottle is fitted with a cork which is perforated by the cork-borer or rat-tail file (see Figs. 150 and 151, page 113), so as to admit of two tubes, the smaller for the ingress of air passing nearly to the bottom of the bottle, while the larger, which is bent to be applied to the mouth, may have its origin just below the bottom of the cork. A little cork may be put into the top of the small tube when not in use. In replenishing the inhaler, before each operation, the cork is removed. The tube may be bent by softening it over the flame of an alcohol lamp or gas furnace, and holding it in such a position that its own weight will cause it to bend gradually and uniformly to the required curve.

Vapores. (*Vapors. Inhalations.*)

This is a new class of preparations of the *British Pharmacopœia.*

Vapor Acidi Hydrocyanici. (*Inhalation of Hydrocyanic Acid.*)

Take of Diluted hydrocyanic acid, ten to fifteen minims.
Water (cold), one fluidrachm.

Mix in a suitable apparatus, and let the vapor that arises be inhaled.

Vapor Chlori. (*Inhalation of Chlorine.*)

Take of Chlorinated lime, two ounces.
Water (cold), a sufficiency.

Put the powder into a suitable apparatus, moisten it with the water, and let the vapor that arises be inhaled

Vapor Coniæ. (*Inhalation of Conia.*)

Take of Extract of hemlock, sixty grains.
Solution of potash, one fluidrachm.
Distilled water, ten fluidrachms.

Mix. Put twenty minims of the mixture on a sponge, in a suitable apparatus, so that the vapor of hot water passing over it may be inhaled. The solution of potash is added to free the conia present in the extract. A strong mouse-like odor being emitted is evidence of the genuineness of the vapor.

Vapor Creasoti. (*Inhalation of Creasote.*)

Take of Creasote, twelve minims.
Boiling water, eight fluidounces.

Mix the creasote and water in an apparatus so arranged that air may be made to pass through the solution and may afterwards be inhaled.

Vapor Iodi. (*Inhalation of Iodine.*)

Take of Tincture of iodine, one fluidrachm.
Water, one fluidounce.

Mix in a suitable apparatus, and, having applied a gentle heat, let the vapor that arises be inhaled.

Fumigations.

In various affections it is desirable to have the medicines act on the skin in the form of vapor or gas. For such fumigations, sulphuretted hydrogen is generated by decomposing sulphuret of potassium or calcium with muriatic or nitric acid; nitrous fumes by nitrate of potassium, or of sodium and sulphuric acid; chlorine from chlorinated lime by muriatic acid, or by adding to a mixture of three parts of chloride of sodium and one of black oxide of manganese two parts of sulphuric acid. These are chiefly used for skin diseases, and as antiseptics and disinfectants.

Alcoholic fumigations are made by setting fire to half an ounce or an ounce of alcohol in an ordinary plate; acetic fumigations, by gradually adding vinegar to a hot brick; ammoniacal fumigations, by throwing carbonate of ammonium upon a hot brick, or adding spirits of hartshorn to boiling hot water; such fumigations are generally applied in rheumatic and similar affections.

Fumigations are applied either to a part or to the whole body; the simplest mode of doing it is to envelop the patient in a blanket, while sitting upon a cane-seat chair, and then prepare them under

the chair in the proper manner. The fumes or vapors are then allowed to reach the affected part of the body. The head is not subjected to this treatment unless in the case of vapor baths designed also to reach the lungs.

Disinfectants.

Aromatic fumigations are much employed for correcting the bad odor of sick rooms; aromatic resins and balsams are used for this purpose.

In the Chapter on Perfumery and Toilet Articles some preparations adapted to this use are referred to. Disinfectants which operate on chemical principles are, however, much more effectual.

Prof. R. E. Rogers has directed for some of the hospitals a mixture of lime and sulphate of iron in such proportion that the protoxide of iron is rapidly reduced on exposure to the air, and by its disposition to pass rapidly into sesquioxide readily decomposes effete matters with which it comes in contact, rendering them innoxious. Under the heads of Chlorine and Bromine in Part III., some of these chemical disinfectants are described.

M. Agata, of London, has patented a process for calcining common cockle and other shells found on the sea-shore until they are friable and readily powdered; this powder he mixes with half the quantity of sulphate of iron, thus producing an inodorous powder resembling ochre, which is designed to be mixed in the proportion of one part to a hundred with any feculent matter which it is designed to deodorize. When used for urine two per cent. of common tar is to be added.

Dr. Crace Calvert has recently called attention to the immense utility of carbolic acid (coal tar creasote) as an antiseptic; he states that the addition of two or three drops of this acid to a pint of freshly made urine will preserve it from any marked chemical change for several weeks. (*See* Ozone, p. 130.)

CHAPTER VI.

CERATES, OINTMENTS, AND LINIMENTS.

These classes of preparations are widely separated in the *Pharmacopœia*, where an alphabetical arrangement is adopted, but they so closely resemble each other in a pharmaceutical point of view as to be naturally associated in a work like the present.

The difference between a cerate and an ointment is in their relative firmness and fusibility; the former is designed to be adhesive at the temperature of the body, so as to be applied in the form of a dressing or sort of plaster; the latter is intended to be rubbed upon the surface or applied by inunction; this distinction is, however,

not absolute, and the two classes nearly approach each other in properties; the name cerate is derived from cera, wax, and most of the cerates, as also some of the oitments, contain this ingredient.

The medicinal ingredients which enter into these classes of preparations are very numerous; indeed, almost every kind of medicine capable of exercising a topical effect may be prescribed in this form.

The unctuous ingredients used in ointments are chiefly bland and unirritating fats and fixed oils, with more or less wax; the reader is referred, for some account of these, to pages 382–398.

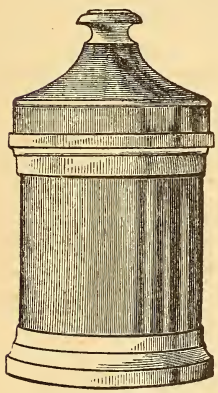
The preparation of inodorous grease is accomplished by repeated washing with water; this may be done ou a slab a little on the incline, a stream of water being set to trickle over it; the surface of the grease is then constantly renewed by an operator working a muller over it in the same way that a color-maker grinds paints in oil. The firmer kinds, such as suet, require more powerful mechanical arrangements for washing them, and in fact in France this purifying of fats is a separate branch of business, the perfumers being the chief consumers of these elegant products.

Of the different ingredients of cerates and ointments *lard* and *suet* resemble each other in most of their properties, except that the latter is more solid and fuses at a higher temperature, while *spermaceti* is still more firm, almost brittle in consistence, and fuses with still less facility; it is recommended by a beautiful pearly whiteness which it imparts, to a certain extent, to its oily combinations. *Wax* is more tough in consistence and still less fusible, its chief use being to give body to cerates and the stiffer ointments.

The uses of *resin* and *turpentine* are twofold, to give body to the cerates into which they enter, and to render them useful as stimulants and fit vehicles for other stimulating substances.

The greatest practical difficulty with ointments arises from their tendency to become rancid by keeping, particularly in warm climates; this is best overcome by observing to free them from moisture by the application of well-regulated heat till the adhering water is entirely evaporated, and to keep them in well-covered jars. The ointment jar, Fig. 247, is made for the purpose, but as the lid is not air-tight, a piece of stout tin-foil, or of bladder, or of waxed paper, should be stretched over the top before covering it with the lid.

Fig. 247.



Ointment jar.

Ointments made with the fixed oils and a suitable proportion of wax, suet, or cocoa-butter, are less liable to rancidity than those made with lard, and the introduction into the latter of small portions of balsams and some essential oils seems to have a favorable effect upon this tendency; and it is observed that the resinous ointments are not liable to it.

A frequent cause of rancidity, in even freshly prepared oint-

ments and cerates made from materials perfectly free from rancidity, is the absorbent character of the jars used to keep them in; the glazing after a short time becomes full of fine cracks through which the grease permeates to the body of the jar; the grease, by frequent exposure to the air, becomes rancid, and in turn imparts rancidity to the ointment placed in it. A very elegant style of jar, but quite expensive, being the real porcelain or china vase, is free from this objection. Glass tumblers small enough to fit inside of the jar may be used with great advantage in overcoming this trouble.

Classification.

For the purposes of study, the cerates and ointments may be thus classified:—

1*st.* Those adapted to use as vehicles for medicinal substances.

2*d.* Those prepared by the fusion of their medicinal ingredients together.

3*d.* Those prepared from the first, or from lard alone, by mechanical incorporation with some active medicinal agent.

4*th.* Those in which the unctuous ingredient is decomposed in the process of preparation.

So great a variety of ointments and cerates have been made officinal, that there seems less occasion for departing from the national standards than in the other classes of extemporaneous preparations.

Of these classes, all which are officinal in the *U. S. Pharmacopœia* are displayed according to the above classification in the following *Syllabi*, and the leading points of interest in connection with them are given further in detail; the working formulas from the *Pharmacopœia* are given, and the unofficinal, which are deemed of sufficient importance for insertion, are described in connection with the appropriate formulas for their preparation.

FIRST GROUP.—*Cerates and Ointments, much used as Vehicles for Medicinal Substances.*

Ceratum saponis.	2 p. soap plaster, 2½ p. white wax, 4 p. olive oil.	*Firmest* "healing" dressing.
Ceratum.	1 part white wax, 2 lard.	*Firmer* "healing" dressing.
Ceratum cetacei.	1 p. spermaceti, 3 white wax, 5 olive oil.	*Firm* "healing" dressing.
Unguentum.	1 part yellow wax, 4 lard.	*Softer* "healing" dressing.
Ung. aquæ rosæ.	Almond oil, sp. ceti, white wax, rose-water.	*Softest* "healing" dressing.
Unguentum benzoini.	1 part benzoin, 16 lard.	Vehicle, consistence of lard.
Ceratum resinæ.	5 parts resin, 8 parts lard, 2 parts yellow wax.	*Stimulant* dressing.

Preparation and Uses.

All these are simple in their mode of preparation; the ingredients are to be placed in a skillet or capsule, and brought to the melting point, care being taken not to burn them, which may be known by the melted mass giving off the odor and appearance of smoke. When there is a great difference in the fusing points, the

least fusible shall be placed over the fire first, and the others added afterwards, so as to involve no unnecessary application of heat. Then the whole is to be stirred or triturated together till thickened by cooling into a homogeneous soft mass; it may now be set away to harden by further cooling. With a view to the whiteness and smoothness of the product, it is best that the melted ingredients should be poured while fluid, though not too hot, into a mortar, in which they should be triturated with a pestle till firm. If spermaceti is an ingredient, the mortar should be warmed to obviate its tendency to separate in a granular condition on contact with a cool surface; when rose-water is added, as in the case of "cold cream," it is well to warm it a little, otherwise it may chill the spermaceti to its solidifying point and deposit it in a granular condition before the mixed oil and wax are sufficiently stiffened to be homogeneous with it.

The use of a mortar in the preparation of cerates and ointments of this class is often obviated by stirring the melted preparation in the vessel in which it was heated, or that to which it is transferred for keeping, with a wooden spatula, till it thickens beyond the danger of separation; but, on the whole, the use of the mortar is most approved. Some pharmacists keep a marble or large wedgwood mortar for the special purpose; it is so difficult to remove every trace of grease that it is not desirable to use the same mortar for this use and the general purposes of the shop. When the mortar is to be warmed, an ounce or two of alcohol may be poured into it and burned. When a marble slab or tile is used, it may be warmed over a slow and diffused gas flame, or the furnace shown in Fig. 127, without the wire gauze attachment, or laid a few minutes on a heated stove.

The first five preparations on the above list are distinguished by different degrees of firmness and fusibility; they are all perfectly bland and unirritating, and are used for their property of protecting the part to which applied from external irritating causes and from the drying action of the air.

Ceratum saponis, as now directed to be made by the improved process of the *Pharmacopœia*, is an elegant application to exposed surfaces, requiring to be spread on some suitable fabric; it is too firm to be conveniently incorporated with medicinal ingredients, except by the aid of heat, but would be a very suitable vehicle for some of the alterative and mild astringent remedies, if softened at the time of their admixture.

Simple cerate, *ceratum adipis*, of U. S. P. 1860, like the foregoing, is almost exclusively applied to blistered or other exposed surfaces, for the complete exclusion of the atmosphere and the prevention of desiccation during the process of healing; it is not adapted to use as a vehicle for medicinal substances *to be applied by inunction*, nor can it be conveniently mixed with powders at ordinary temperatures. From overlooking this fact, the mistake is constantly made by physicians of prescribing simple cerate as the vehicle for iodine, the mercurials, etc.; and in view of this, some of the apothecaries

vary the proportions, putting in one-fourth instead of one-third wax; this partially unfits it for the use for which it is mainly designed, to furnish a firm dressing which will not fuse entirely at the temperature of the body.

Simple cerate, as is well-known, is very liable to become rancid by exposure to the air; the late Ferris Bringhurst, in a report to the American Pharmaceutical Association, pointed out the superiority of cerate made with unbleached yellow wax. (*See* paper in *Proceedings*, vol. xvi. 416.)

Simple ointment, *ointment of lard* of U. S. P. 1860, is designed for the purpose just mentioned as not suited to the cerate, that of furnishing, in warm weather, a good vehicle for medicines in the form of ointment. In the winter, it is frequently replaced by lard, when that vehicle can be obtained fresh and sweet. It is not unusual to add to simple cerate and simple ointment, when fused in the process of preparing them, a little rose-water, and sometimes a very small portion of borax, which renders them very white without interfering with their remedial qualities.

Spermaceti cerate is intermediate between the foregoing, and has the advantage of being made without the use of lard, which is sometimes difficult to procure of good quality, and always objectionable for use about the face; it is an elegant preparation, though dependent for its whiteness and sweetness upon the quality of the olive oil employed in making it. It is a perfectly bland and unirritating application, better adapted to use as a healing dressing than as a vehicle for more active medicines.

Ointment of rose-water, commonly called "cold cream," is an application adapted to chapped or excoriated skin, and may be used as a substitute for lard as an excipient for medicines to be applied by inunction; an unofficinal formula, containing wax instead of spermaceti, is given among the working formulas, which is highly approved among some *connoisseurs*.

Benzoated lard is the name applied to the new officinal Unguentum benzoini, adapted to replace lard in seasons and in situations in which commercial lard would become rancid; its pleasant balsamic odor also recommends it in preference to ordinary lard; it is, however, not white, and on that account less elegant than the ointment of rose-water or glycerin ointment.

Resin cerate or basilicon, though included in the series, is not, like the others, free from irritating properties; it is much used as an application to burns and chilblains, and as a dressing to blistered surfaces with a view to keep up the discharge; it is also a very suitable vehicle for stimulating applications in the form of powder incorporated by the aid of heat. The resin present is also useful by preventing the tendency to rancidity to which unctuous ingredients are liable.

SECOND GROUP.—*Those in which the Medicinal Substances are mixed with the Unctuous Ingredient by Fusion and Digestion.*

Cerat. resinæ comp.	Resin, suet, yellow wax, turpentine, flaxseed oil.	Stimulating.
Unguent. picis liq.	Tar and suet, equal parts.	Stimulating antiseptic.
Ceratum cantharidis.	Canth., 12 parts; lard, 10 parts; yellow wax, resin, each, 7 parts.	Epispastic (Blistering Cerate).

REMARKS.

Compound resin cerate, or *Deshler's salve*, is both firmer and more stimulating than basilicon, though used for similar purposes in burns, scalds, etc.; it is too firm for ready incorporation with dry powders, and is mostly used by itself. An inconveniently tough consistence is one of the disadvantages attendant upon this preparation, though when it has been suitably spread, it forms a very good and adhesive application.

Tar ointment, which is made by melting suet, and, while it is fluid, stirring into it an equal weight of tar until it cools and thickens, is used in scald head and various scaly eruptions with excellent effects.

Blisters and Blistering Cerates.

Ceratum cantharidis is conveniently made by the working formula appended by melting together lard, wax, and resin, and sifting into the fused mass, powdered Spanish flies, continuing the heat for half an hour, and then removing from the fire and stirring till cool; the active principle of the flies, *cantharidin*, is extracted to a great extent by this digestion in the grease, and the powder itself is also retained and adds to the effect of the preparation.

This is sometimes kept in jars, and sometimes, by increasing the proportion of wax and resin a very little, is made firm enough to roll out into rolls like plasters.

Blistering cerate, when ordered in prescription as a cerate to be dispensed by weight and spread at the bedside of the patient, is ordered by its officinal name; when designed to be spread as a plaster, it is called *Emplastrum epispasticum*, the size being generally conveyed thus, 3 × 6 (meaning three inches wide by 6 long), or any other size desired, or a pattern may accompany, giving the shape and size. Sometimes the purpose for which it is required is expressed, and the precise size and shape are left to the pharmacist; at others, it is left optional with the attendant whether to spread the blister himself, or to have it spread at the shop by a prescription like the following: ℞.—Carati cantharidis, q. s., ut fiat emplastrum epispasticum 3 × 6.

Besides the familiar Ceratum cantharidis, the *Pharmacopœia* now recognizes a preparation under the name *Ceratum extracti cantharides*, in which an alcoholic extract of the flies is mixed with resin, wax, and lard; it is a more elegant preparation, but is as yet but little prescribed. It is well adapted to dilution with simple cerate in the proportion of one part to four or eight as a stimulating

dressing to blistered surfaces for maintaining their discharge and preventing healing. (*See* Working Formulas.)

The best material on which to spread a blister is adhesive plaster cloth; if a wide margin is left, it is readily made to adhere by warming the margin over a lighted lamp, and pressing it carefully on to the part. It should also be so incised from the edges inward as to be readily adapted to the inequalities of the surface to which applied. Kid or split sheepskin, or even thick glazed paper, also answer a good purpose, in which case the margin is made very narrow, and three or four strips, about half an inch wide, of adhesive plaster are warmed and drawn over the outside to hold it in its place.

Blisters to be applied behind the ears are much prescribed; in spreading these care must be taken to have them the reverse of each other, or, after they are spread, it may be found they both fit the same ear. It is well, in the case of these, to leave the margin much the widest at the part furthest from the ear and below, where the hair will not interfere with its adhesion.

The mode of spreading blisters is too simple to require comment; in cold weather, or when the cerate is very stiff, I use the thumb, which makes a smooth and very neat surface; a spatula slightly warmed answers very well. After the blister is spread, it is well to paint over its surface with ethereal tincture of cantharides, which increases its activity, or lay a piece of tissue paper over its whole surface, and coat this with the ethereal tincture.

It is considered a good precaution to remove the blister as soon as it has thoroughly reddened the skin, and then to apply a cataplasm of bread and milk, elm bark, or ground flaxseed, to raise the skin. A blistering plaster usually requires from six to twelve hours to raise the skin.

The different *blistering tissues* are, I believe, all made by extracting cantharidin from the flies with ether or oil of turpentine, and forming it into a plaster, which is then spread on paper, silk, or other suitable fabric. The proportions indicated by Mohr and Redwood are as follows: To one part of the yellowish oily residue left after the evaporation of the ether from ethereal tincture of flies, add two parts of melted white wax, and spread a thin layer over the surface of paper.

The following formula is from the *London Pharmaceutical Journ.*, 1860:—

Take of Cantharidin	gr. j.
White wax	ʒj
Olive oil	ʒv

Melt together. With a brush paint it over some white bibulous paper and hang it up to dry in a current of air. Take a piece of pink paper of the form and size required; the under colored side paint over with a weak solution of India rubber (or gutta-percha), cut the cantharidin paper to the form and size of the pink paper, less a margin, and while the pink paper is still sticky place the other

upon it. Before applying, this blister should be held over the steam escaping from a vessel of hot water.

Charta Cantharidis, U. S. P. (*Cantharides Paper.*)

Take of White wax, four troyounces.
Spermaceti, one and a half troyounce.
Olive oil, two troyounces.
Canada turpentine,
Cantharides, in powder, each, half a troyounce.
Water, five fluidounces.

Mix all the substances in a tinned vessel, and boil gently for two hours, constantly stirring. Filter through a woollen strainer without expressing, and keep the mixture in a liquid state by means of a shallow water-bath with an extended surface. Coat strips of paper upon one side only with the melted plaster, by passing them successively over the surface of the liquid, and cut the strips when dry into rectangular pieces.

Charta Sinapis, U. S. P. (*Mustard Paper.*)

Take of Black mustard, in powder, ninety grains.
Solution of gutta-percha, a sufficient quantity.

Mix the mustard with as much of the solution as may be necessary to give it a similiquid consistence; then apply the whole of the mixture by means of a suitable brush to a piece of rather stiff paper four inches square, so as completely to cover one side of it, and allow the surface to dry. Before being applied to the skin, let the mustard paper be dipped for about fifteen seconds in warm water.

These two preparations are new officinals in the last edition of the *U. S. Pharmacopœia*, and are designed to supply the places of popular remedies of this class. They are to be greatly commended on the score of cleanliness, efficiency, and portability.

THIRD GROUP.—*Cerates and Ointments, in which the Medicinal Ingredients are incorporated by trituration with the Unctuous Ingredients.*

Cerat. sabinæ.	Fluid ext. from 1 part savin. 4 parts resin cerate.	Stimulating dressing applied to blisters.
Ung. gallæ.	1 part powdered galls. 7 parts lard.	Astringent, used in piles.
Ung. acidi carbolici.	1 part carbolic acid. 7 parts simple ointment.	Antiseptic.
Ung. acidi tannici.	ʒss + Aq. fʒss to ℥j lard.	Astringent, used in piles.
Ung. veratriæ.	℈j to ʒj lard.	An anodyne in neuralgia.
Cerat. zinci carb.	1 part $ZnCO_3$. 5 parts ointment of lard.	Mild astringent and desiccant.
Ung. zinci oxidi.	1 part ZnO, 5 parts lard.	Mild astringent and desiccant.
Ung. antimonii.	1 part tart. ant. et potass. 4 parts lard.	Vesicant, producing pustular eruptions.
Ung. hydrargyri.	2 parts mercury. 1 each lard and suet.	Alterative, used to produce mercurial impression.
Ung. hydrar. ammon.	1 part NH_2HgCl. 12 parts simple ointment.	Alterative, desiccant.
Ung. hyd. iod. rub.	gr. xvi to ʒj.	Discutient.
Ung. hyd. oxid. flav.	1 part HgO. 7 parts ointment.	Stimulant.
Ung. Cantharidis.	1 part cer. canth. 3 parts resin cerate.	Stimulant.

Ung. hyd. oxid. rub.	1 part HgO (fine powder). 8 parts ointment of lard.	Stimulating, alterative.
Ung. iodinii.	1 part I, $\frac{1}{3}$ part KI. 24 parts lard + Aq.	Discutient, alterative.
Ung. iodinii comp.	1 part I, 2 parts KI. 32 parts lard.	Discutient, alterative.
Ung. potassii iodid.	1 part KI + 1 part Aq. 8 parts lard.	Discutient, alterative.
Ung. plumbi carb.	1 part $PbCO_3$. 7 parts ointment of lard.	Astringent and desiccant.
Ung. plumbi iodidi.	1 part PbI_2. 7 parts ointment.	Discutient.
Ung. sulphuris.	1 part S to 2 lard.	Specific in itch.
Ung. belladonnæ.	1 part extract, 8 lard.	Anodyne.
Ung. stramonii.	1 part extract, 7 lard.	Anodyne.
Ung. tabaci.	Aqueous ext. from 1 part to 16 parts lard.	Anodyne.
Ung. creasoti.	f ℥ss to lard ℥j.	Antiseptic, mild escharotic.
Ung. zinci oxidi.	Gr. 80 to ointment benzoin 400 grs.	Desiccant.

It would extend this chapter beyond convenient limits to dwell in detail upon each of these numerous officinal triturated ointments. They may be made in a mortar with the use of the pestle, or on a tile or slab with a spatula. The medicinal ingredients of a dry substance should be invariably in a very fine powder before incorporating it with the ointment. (*See* chapter on Dispensing.) This condition may be attained without the necessity of soiling a mortar, by the use of a muller. *Iodine* is a crystalline substance which cannot be conveniently reduced to fine powder, and is therefore directed to be dissolved by the use of iodide of potassium and a few drops of water. In a few instances it is found necessary to soften the unctuous ingredients beforehand by a moderate heat, applied either to the spatula or by warming the tile; the combustion of a little alcohol on the surface of a tile will give it the requisite warmth without the risk of fracturing it by the application of heat from beneath.

The use of the *narcotic extracts* in the preparation of ointments is a recent improvement, and may be extended to all medicines of that class, including opium, which in aqueous extract, possesses advantages over the powdered drug.

Belladonna and *stramonium* ointments, as shown in the syllabus, are made by trituration from the extracts, taking care to soften the extract by triturating with water before adding the simple ointment or lard. This process is only adapted to small quantities to be speedily used, it will separate in warm weather by the softening of the lard, and is liable to be gritty on account of the formation of crystals of oxalate of potassa in the extracts.

Aconite ointment is made in the same way and in the same proportion, ℥j to ℥j.

Red precipitate ointment (ung. hydr. oxid. rub.) is a very important preparation, being most extensively used as an eye-salve and the basis of many of the popular medicines of that description. By trituration, the oxide becomes changed to an *orange-colored* powder, which imparts a similar hue to the ointment; it is variously diluted

to meet the case for which prescribed; when it becomes rancid it assumes a red color, or changes to blue, and should be thrown away.

Fourth Group.—*In which the Fatty Ingredient is Chemically Changed.*

Ung. hydrargyri nitratis. A powerful stimulant, "sub-caustic," and alterative.
Cerat. plumbi subacetatis. A cooling sedative application.

This group, containing one each of the officinal classes unguenta and cerata, has been reduced by the transfer of ceratum saponis, by the substitution of an improved process, to the first group.

Citrine Ointment.—The first named is made by adding an acid solution of nitrate of mercury to lard heated to 200°, an effervescence occurs, sometimes inconveniently, and by stirring with a wooden or horn spatula the ointment subsides in the form of a beautiful citrine-colored mass of convenient consistence, which is much esteemed as a "sub-caustic" application. The oil undergoes a change in this process, being, as is supposed, partially converted into elaidin and elaic acid, and the nitrate of mercury being reduced to a yellow sub-nitrate. Owing to circumstances not fully understood this preparation varies much in consistence and in color, sometimes too by age it is changed to a dark color by the deposition of suboxide of mercury, when fusion for a short time with a little nitric acid will restore the color.

Much of the trouble experienced in obtaining a handsome ointment of good consistence will be avoided by adding the mercurial solution at a temperature of about 108° F.

Goulard's cerate of subacetate of lead is a very desirable cooling application, but of all the officinal ointments is the most prone to change; a sort of lead soap is formed by the action of the solution of subacetate upon the melted oily mixture. The preparation should have a rich, yellowish-green tinge, derived from the olive oil, and a pleasant odor of camphor, without rancidity. If perfectly excluded from the air it will keep pretty well, but should be made in small quantity. When of a white color and rancid odor it should be invariably rejected as worse than worthless. (*See* Extemporaneous Process, page 872.)

Working Formulas for Preparing the Cerates and Ointments.

Cerata.

Ceratum, U. S. P. (*Cerate.*)

Ceratum Adipis, *U. S. P.* 1860.

Take of Lard, eight troyounces.
White wax, four troyounces.

Melt them together, and stir the mixture constantly until cool.

Ceratum Cantharidis, U. S. P. (*Blistering Cerate.*)

Take of Cantharides, in very fine powder, twelve troyounces.
Yellow wax,
Resin, each, seven troyounces.
Lard, ten troyounces.

To the wax, resin, and lard, previously melted together, and strained through muslin, add the cantharides, and, by means of a water-bath keep the mixture in a liquid state for half an hour, stirring occasionally. Then remove it from the water-bath, and stir it constantly until cool.

It is important and essential to making the cerate smooth and efficient that the flies should be reduced to an extremely fine powder and passed through a bolting cloth, as many particles of the flies are very light and pass over in dusting, which when mixed in the cerate will render it very uneven and unsightly.

Ceratum Cetacei, U. S. P. (*Cerate of Spermaceti.*)

Take of Spermaceti, a troyounce.
White wax, three troyounces.
Olive oil, five troyounces.

Melt together the spermaceti and wax; then add the oil previously heated, and stir the mixture constantly until cool.

Ceratum Extracti Cantharidis, U. S. P. (*Cerate of Extract of Cantharides.*)

Take of Cantharides, in fine powder, five troyounces.
Stronger alcohol, two pints and a half, or a sufficient quantity.
Resin, three troyounces.
Yellow wax, six troyounces.
Lard, seven troyounces.

Moisten the cantharides with stronger alcohol, pack them in a cylindrical percolator, and gradually pour on stronger alcohol, until the liquid passes nearly colorless. Evaporate the filtered liquid, by means of a water-bath, to the consistence of a soft extract. Mix this with the resin, wax, and lard, previously melted together, and keep the whole at the temperature of 212° for fifteen minutes. Lastly, strain the mixture through muslin, and stir it constantly until cool.

Ceratum Plumbi Subacetatis, U. S. P.* (*Goulard's Cerate.*)

Take of Solution of subacetate of lead, two fluidounces and a half.
White wax, four troyounces.
Olive oil, eight troyounces.
Camphor, thirty grains.

Mix the wax, previously melted, with seven troyounces of the oil. Then remove the mixture from the fire, and, when it begins to thicken, gradually pour in the solution of subacetate of lead, stirring constantly with a wooden spatula until it becomes cool. Lastly, add the camphor dissolved in the remainder of the oil, and mix them.

A second formula is given in the *Pharmacopœia*, which admits of its being made extemporaneously, and this in the editor's opinion is the better course, as the cerate made by the first formula is rarely good if prepared even for a short time.

* See remarks on page 870.

Take of Cerate, three hundred and fifty grains.
Olive oil, fifty grains.
Solution of subacetate of lead, a fluidrachm and a half.
Liniment of camphor, twelve grains.

Mix intimately.

Ceratum Resinæ, U. S. P. (*Basilicon Cerate.*)

Take of Resin, ten troyounces.
Yellow wax, four troyounces.
Lard, sixteen troyounces.

Melt them together, strain the mixture through muslin, and stir it constantly until cool.

Ceratum Resinæ Compositum, U. S. P. (*Deshler's Salve.*)

Take of Resin,
Suet,
Yellow wax, each, twelve troyounces.
Turpentine, six troyounces.
Flaxseed oil, seven troyounces.

Melt them together, strain the mixture through muslin, and stir it constantly until cool.

Ceratum Sabinæ, U. S. P. (*Cerate of Savine.*)

Take of Fluid extract of savine, three fluidounces.
Resin cerate, twelve troyounces.

Melt the cerate, add the fluid extract, and stir them together at a moderate heat till the alcohol has evaporated, then stir till cool.

Ceratum Saponis, U. S. P. (*Soap Cerate.*)

Take of Soap plaster, two troyounces.
White wax, two troyounces and a half.
Olive oil, four troyounces.

Melt together the plaster and wax, add the oil, and, after continuing the heat a short time, stir the mixture until cool.

Ceratum Zinci Carbonatis, U. S. P.

Substitute for Ceratum Calaminæ, *Pharm.* 1850.

Take of Precipitated carbonate of zinc, two troyounces.
Ointment of lard, ten troyounces.

Mix them.

Unguenta.

Unguentum, U. S. P. (*Unguentum Adipis*, Pharm. 1860.)

Take of Lard, eight troyounces.
Yellow wax, two troyounces.

Melt them together with a moderate heat, and stir the mixture constantly while cooling.

Unguentum Acidi Carbolici, U. S. P.

Take of Carbolic acid, sixty grains.
Ointment, four hundred and twenty grains.

Mix them thoroughly.

Unguentum Acidi Tannici, U. S. P.

Take of Tannic acid, thirty grains.
Water, half a fluidrachm.
Lard, a troyounce.

Rub the acid first with the water, and then with the lard, until they are thoroughly mixed, avoiding the use of an iron spatula.

Unguentum Antimonii, U. S. P. (*Tartar Emetic Ointment.*)

Take of Tartrate of antimony and potassa, in very fine powder, one hundred and twenty grains.
Lard, a troyounce.

Rub the powder with a little of the lard, then add the remainder and thoroughly mix them.

Unguentum Aquæ Rosæ, U. S. P. (*Cold Cream.*)

Take of Oil of sweet almond, three troyounces and a half.
Spermaceti, a troyounce.
White wax, one hundred and twenty grains.
Rose water, two fluidounces.

Melt together, by means of a water-bath, the oil, spermaceti, and wax; then gradually add the rose water, and stir the mixture constantly while cooling.

Unguentum Belladonnæ, U. S. P. (*Ointment of Belladonna.*)

Take of Extract of belladonna, sixty grains.
Water, half a fluidrachm.
Lard, four hundred and twenty grains.

Rub the extract first with the water until rendered uniformly soft, then with the lard, and thoroughly mix them.

Unguentum Benzoini, U. S. P. (*Benzoated Lard.*)

Take of Benzoin, in moderately coarse powder, a troyounce.
Lard, sixteen troyounces.

Heat them together, by means of a water-bath, for two hours, with occasional stirring; then strain without pressure, and stir the product constantly while cooling.

Unguentum Creasoti, U. S. P. (*Ointment of Creasote.*)

Take of Creasote, half a fluidrachm.
Lard, a troyounce.

Mix them.

Unguentum Gallæ, U. S. P. (*Gall Ointment.*)

Take of Nutgall, in very fine powder, a troyounce.
Lard, seven troyounces.

Mix them.

Unguentum Hydrargyri Iodidi Rubri, U. S. P.

Take of Red iodide of mercury, in very fine powder, sixteen grains.
Ointment, a troyounce.

Rub them together till they are thoroughly mixed.

Unguentum Hydrargyri,* U. S. P. (*Ointment of Mercury.*)

Take of Mercury, twenty-four troyounces.
Lard,
Suet, each, twelve troyounces.

Rub the mercury with a troyounce of the suet and a small portion of the lard, until the globules cease to be visible, then add the remainder of the lard, and of the suet softened with a gentle heat, and thoroughly mix them.

Unguentum Hydrargyri Ammoniata, U. S. P. (*White Precipitate Ointment.*)

Take of Ammoniated mercury, in very fine powder, forty grains.
Ointment of lard, a troyounce.

Mix them.

Unguentum Hydrargyri Nitratis, U. S. P. (*Citrine Ointment.*)

Take of Mercury, a troyounce and a half.
Nitric acid, three troyounces and a half.
Lard, sixteen troyounces and a half.

Dissolve the mercury in the acid, then heat the lard in an earthen vessel, and when the temperature reaches 200° remove the mixture from the fire. To this add the mercurial solution, and, with a wooden spatula, stir constantly so long as effervescence continues, and afterwards occasionally until the ointment stiffens.

Unguentum Hydrargyri Oxidi Flavi, U. S. P. (*Ointment of Yellow Oxide of Mercury.*)

Take of Yellow oxide of mercury, in very fine powder, sixty grains.
Ointment, four hundred and twenty grains.

Rub the oxide with the ointment gradually added until they are thoroughly mixed.

Unguentum Hydrargyri Oxidi Rubri, U. S. P. (*Red Precipitate Ointment.*)

Take of Red oxide of mercury, in very fine powder, sixty grains.
Ointment of lard, four hundred and twenty grains.

Add the oxide of mercury to the ointment previously softened with a gentle heat, and thoroughly mix them.

This ointment should have a distinctly orange-color, and should be free from rancidity and grit.

Unguentum Cantharidis, U. S. P. *Ointment of Cantharides.*

Take of Cantharides cerate, one hundred and twenty grains.
Resin cerate, three hundred and sixty grains.

Mix them thoroughly.

* This ointment is usually made by manufacturers on a large scale, as it sometimes contains only one part of mercury to two or three of the unctuous ingredients. When ordering it, the physician should specify "*one-half mercury.*" Its uses are numerous, one of the chief of which is that of inducing the mercurial impression by its application to the thighs, armpits, etc. The numerous curious synonyms applied to this ointment it would be interesting to collect.

Unguentum Iodinii, U. S. P. (*Ointment of Iodine.*)

Take of Iodine, twenty grains.
Iodide of potassium, four grains.
Water, six minims.
Lard, a troyounce.

Rub the iodine and iodide of potassium first with the water, and then with the lard until they are thoroughly mixed.

Unguentum Iodinii Compositum, U. S. P. (*Compound Ointment of Iodine.*)

Take of Iodine, fifteen grains.
Iodide of potassium, thirty grains.
Water, thirty minims.
Lard, a troyounce.

Rub the iodine and iodide of potassium first with the water, and then with the lard, until they are thoroughly mixed.

Unguentum Mezerei, U. S. P. (*Mezereon Ointment.*)

Take of Fluid extract of mezereon, four fluidounces.
Lard, fourteen troyounces.
Yellow wax, two troyounces.

Melt the lard and wax together with a moderate heat, add the fluid extract of mezereon, and stir the mixture constantly until the alcohol has evaporated, then continue to stir while cooling.

Unguentum Picis Liquidæ, U. S. P. (*Tar Ointment.*)

Take of Tar,
Suet, each, twelve troyounces.

Mix the tar with the suet previously melted with a moderate heat, and having strained the mixture through muslin, stir it constantly while cooling.

Unguentum Plumbi Carbonatis, U. S. P. (*Ointment of Carbonate of Lead.*)

Take of Carbonate of lead, in very fine powder, sixty grains.
Ointment of lard, four hundred and twenty grains.

Add the carbonate of lead to the ointment previously softened with a gentle heat, and thoroughly mix them.

Unguentum Plumbi Iodidi, U. S. P. (*Ointment of Iodide of Lead.*)

Take of Iodide of lead, in very fine powder, sixty grains.
Ointment, four hundred and twenty grains.

Rub the iodide of lead with the ointment gradually added, until they are thoroughly mixed.

Unguentum Potassii Iodidi, U. S. P. (*Ointment of Iodide of Potassium.*)

Take of Iodide of potassium, in fine powder, sixty grains.
Water, a fluidrachm.
Lard, four hundred and twenty grains.

Dissolve the iodide of potassium in the water in a warm mortar, then add the lard gradually and thoroughly mix them.

Unguentum Stramonii, U. S. P. (*Ointment of Stramonium.*)

Take of Extract of stramonium, sixty grains.
Water, half a fluidrachm.
Lard, four hundred and twenty grains.

Rub the extract first with the water until rendered uniformly soft, then with the lard, and thoroughly mix them.

Unguentum Sulphuris, U. S. P. (*Ointment of Sulphur.*)

Take of Sublimed sulphur, a troyounce.
Lard, two troyounces.
Mix them.

Unguentum Sulphuris Iodidi, U. S. P. (*Ointment of Iodide of Sulphur.*)

Take of Iodide of sulphur, thirty grains.
Lard, a troyounce.

Rub the iodide of sulphur, first reduced to a fine powder, with a little of the lard, then add the remainder, and thoroughly mix them.

Unguentum Tabaci, U. S. P. (*Ointment of Tobacco.*)

Take of Tobacco, in fine powder, half a troyounce.
Lard, eight troyounces.
Water, a sufficient quantity.

Moisten the tobacco with a little water, introduce it into a conical glass percolator, and, having pressed it firmly, pour water upon it until four fluidounces of filtered liquid have passed. Evaporate this to the consistence of a soft extract, and mix it thoroughly with the lard.

Unguentum Veratriæ, U. S. P. (*Ointment of Veratria.*)

Take of Veratria, twenty grains.
Lard, a troyounce.

Rub the veratria with a little of the lard; then add the remainder and thoroughly mix them.

Unguentum Zinci Oxidi, U. S. P. (*Ointment of Oxide of Zinc.*)

Take of Oxide of zinc, eighty grains.
Ointment of benzoin, four hundred grains.
Mix them thoroughly.

Selections from Unofficinal Cerates and Ointments.

Glycerin Ointment. (J. H. Eckey.)

Take of Spermaceti	℥ss.
White wax	℥j.
Oil of almonds	f ℥ij.
Glycerin	f ℥j.

Melt the wax and spermaceti with the oil of almonds at a mode-

rate heat; put these into a wedgewood mortar, add the glycerin, and triturate until cold.

Glycerin can only be incorporated with fats when they are softened to about its consistence; it is not, like an oil, a solvent for fats. This is a bland and pleasant application, which if desired may be appropriately perfumed to render it more popular.

Cold Cream. (Dr. L. Turnbull's Recipe.)

Take of White wax	℥j.
Oil of almonds	f℥iv.
Rose-water	f℥ij.
Borax	ʒss.
Oil of roses	♏v.

Let the wax be melted and dissolved in the oil of almonds by a gentle heat, then dissolve the borax in the rose-water and add the solution to the heated oil, stirring constantly till cool; then add the oil of roses, stirring. It is well to warm the rose-water a little, or to add it to the ointment before it is much cooled, thus preventing any granulation of the wax; to secure the advantage of the borax the quantity of rose-water ought to be increased to at least f℥v and that slightly warmed, as borax requires twelve parts of water for solution.

Thus prepared, cold cream is a beautiful snow-white, smooth, bland ointment, about the consistence of good lard, and an admirable substitute for that excipient. It is too soft for a convenient lip salve, and the following is preferred:—

Rose Lip Salve.

Take of Oil of almonds	℥iij.
Alkanet	ʒij.

Digest with a gentle heat and strain; then add—

White wax	℥iss.
Spermaceti	℥ss.

Melt with the colored oil and stir it until it begins to thicken, then add—

Oil of rose geranium	gtt. xxiv.

This may be put into small metallic boxes for the waistcoat pocket.

Elemi Ointment.

Take of Elemi (resin)	℥ij.
Simple cerate	℥ij.
Resin cerate	℥ss.
Peruvian balsam	ʒss.

Fuse together and mix thoroughly.

It is much prescribed by Prof. Pancoast, of the Jefferson Medical College, as an elegant substitute for resin cerate.

The *London Pharmacopœia* contains another formula, which nearly agrees with the following, of the *Prussian Pharmacopœia*:—

Take of Elemi,
Turpentine,
Suet,
Lard, each, equal parts.

Fuse, strain, and mix.

Compound Cerate of Lead.

Take of Cerat. plumbi subacet.,
Cerat. simp., āā . . . . . ℥ss.
Hydrarg. chlor. mit.,
Pulveris opii, āā . . . . . ʒj.

Mix.

Used in cutaneous eruptions of local character.

The above prescription is attributed to Dr. Parrish, Senior.

Improved Tobacco Ointment.

Take of Tobacco leaves . . . . . ℥v.
Vinegar . . . . . Oij.

Digest the leaves in the vinegar till evaporated to Oss; strain and express the liquid, then evaporate by moderate heat to about f℥iij; triturate this with—

Extract of belladonna. . . . . ℥j.

Then take of—

Camphor, in powder . . . . . ʒviss.
Resin cerate . . . . . ℥viss.

Mix these by fusion at a moderate heat, and incorporate them with the mixed extracts of tobacco and belladonna.

This is a very superior stimulating and anodyne application, first published by Wm. J. Allinson, of Burlington, N. J.

Garlic Ointment.

Take of Fresh garlic . . . . . 2 or 3 cloves.
Lard . . . . . ℥j.

Digest at a moderate heat for half an hour, and strain; a useful application to the chest in croup.

Ung. cantharidis, restored in the late edition of the *Pharmacopœia*, is made by mixing ʒij of cerate of cantharides with ʒvj of resin cerate, which, as in the case of savine ointment in the last group, is used as a vehicle. These two ointments are chiefly used for the same purpose, as stimulating applications to blistered surfaces.

Care must be taken to distinguish, in prescriptions, between the cerate and ointment of cantharides; the former being blistering cerate, and the latter only a stimulating dressing for blisters.

Aconitia Ointment.

Take of Aconitia . . . . . gr. xvj.
Olive oil . . . . . ʒss.

Triturate together, and then incorporate with—

Lard . . . . . ℥j.

A good substitute for this very expensive preparation will be found among the liniments.

No. 145.—*Tetter Ointment prescribed by the late Dr. S. G. Morton.*

Take of Calomel,
Alum (dried), in powder,
Carbonate of lead,
Oil of turpentine, each . . . . . ʒij.
Simple ointment . . . . . ℥iss.

Triturate the powders together till they are impalpable and thoroughly mixed, then incorporate them with the oil and cerate.

This is one of the very best ointments of its class, as proved by trials during a series of years.

The mode of using it is to apply it at night, wash off with pure Castile soap in the morning, wipe dry, and dust with pure starch.

Tetter Ointment prescribed by Dr. Physic.

Take of Hydrarg. ammoniat. . . . . ℈j.
Hydrarg. chlor. corros. . . . . gr. x.
Alcoholis . . . . . fʒj.
Plumbi acetatis . . . . . ʒss.
Adipis . . . . . ℥j.

Triturate the corrosive chloride with the alcohol, add the white precipitate and sugar of lead, and make an ointment, to be applied twice daily.

A Salve resembling "Becker's Eye Balsam."

Take of Calamine,
Tutty, of each . . . . . ʒiss.
Red oxide of mercury . . . . . ʒvj.
Camphor, in powder . . . . . ʒj.
Almond oil . . . . . ʒj.
White wax . . . . . ℥iss.
Fresh butter . . . . . ℥viij.

Reduce the mineral substances to a very fine powder, and incorporate with the oil in which the camphor has been dissolved with the wax and butter previously melted together. The butter must be deprived of salt, if present, by washing with warm water.

The reputation of Becker's Eye Balsam is widely extended.

Compound Iron Ointment.

Take of Common iron rust . . . . . ʒiijss.
Powdered red oxide of mercury . . . . . ℥j, ʒj.

Make into an impalpable powder, and add to—

Washed lard . . . . . ℥ij.

For the cure of chronic inflammation of the eyelid (conjunctiva), particularly of a scrofulous character, eruptions on the face and body of young children, etc.

Unguentum Cretæ. (Westminster Hospital.*)

Take of Prepared chalk . . . . . ʒij.
Olive oil . . . . . ʒiss.
Lard . . . . . ʒivss.

Mix.

* From Squire's Pharm. of London Hospitals.

Ung. Picis c. Sulphure. (Middlesex Hospital.*)

Take of Sulphur and tar, of each . . . . . 2 drachms.
Hydro-sulphuret of ammonia . . . . . 5 minims.
Prepared chalk . . . . . 1 drachm.
Lard to make . . . . . 7 drachms.

Mix.

Unguentum Ferri Chloridi. (*Hæmostatic Ointment.**)

Take of Ferri chloridi . . . . . ʒij.
Axungiæ . . . . . ℥j.

Misce.

Ointment of Cod-liver Oil.

Take of Fresh cod-liver oil . . . . . 7 parts.
White wax,
Spermaceti, of each . . . . . 1 part.

Melt together, stirring as it cools.

This is used in ophthalmia and opacity of the cornea, either alone or combined with a little citrine ointment, also as a friction or dressing for scrofulous indurations and sores, in rheumatism, stiff joints, and several skin diseases. It is said to have been used in porrigo or scald-head when other remedies have failed.

Ointment of Croton Oil.

Take of Croton oil . . . . . ♏xxx.
Lard (softened) . . . . . ʒj.

Mix well.

Rubefacient and counter-irritant in rheumatic and other diseases. When rubbed repeatedly on a part, it produces redness and a pustular eruption.

Hufeland's Stimulating Ointment.

Take of Beef gall . . . . . ʒiij.
White soap . . . . . ʒiij.
Althea ointment . . . . . ℥j.
Petroleum . . . . . ʒij.

Mix by the aid of heat, and as it cools add—

Powdered carbonate of ammonium . . . . . ʒss.
Powdered camphor . . . . . ʒj.

Triturate together.

Althea ointment is still officinal in most European *Pharmacopœias;* but some have discontinued it for the use of the mucilaginous decoctions of marshmallow root and flaxseed. Bavarian and Greek *Pharmacopœias* order, instead of it, an ointment of yellow wax and lard, colored by turmeric. The following embraces the directions of the French *Codex* of 1839:—

Take of Powdered fœnugreek . . . . . 2 parts.
Olive oil . . . . . 32 parts.

* From Squire's Pharm. of London Hospitals.

Digest for six hours, strain, and add—

Yellow wax	8 parts.
Burgundy pitch	4 parts.
Turpentine	4 parts.

Strain, and stir until cool.

Pile Ointment.

Take of Acetate of morphia	gr. v.
Tannic acid	ʒss.
Liniment of subacetate of lead	fʒss.
Simple ointment	ʒvij.

Triturate the tannic acid first with the liniment, and then incorporate it with the ointment.

Linimenta, *U. S. P.* (Liniments.)

These are fluid or semifluid preparations designed to be rubbed upon the surface, and either covered by lint or rubbed on until partially absorbed. The officinal members of this class are displayed in the following syllabus.

The Officinal Liniments.

Group 1.—*In which the Oily Ingredient is partially Saponified.*

Linimentum ammoniæ. (Volatile liniment.)	Ammonia water, fʒj. Olive oil, ʒij.	Stimulating, rubefacient.
Linimentum calcis.	Lime-water, fʒviij. Flaxseed oil, ʒvij.	"Healing," or demulcent.
Linimentum saponis.	Castile soap, ʒij. Camphor, ʒj. Oil rosemary, fʒij. Alcohol, Oj. Water, fʒiij.	The soap dissolved in the diluted alcohol by heat, and the stimulants added.

Group 2.—*Oily Mixtures.*

Liniment. cantharidis.	Cantharidis, ʒj. Oil turpentine, Oss.	Digested and strained.
Liniment. camphoræ.	Camphor, 1 part. Olive oil, 4 parts.	Triturated in a mortar.
Liniment. chloroformi.	Chloroform, ʒiij. Olive oil, ʒiv.	Shaken together.
Liniment. terebinthinæ. (Kentish's ointment.)	Resin cerate, ℔j. Oil turpentine, Oss.	Semifluid, by fusing the ingredients together.
Liniment. aconiti.	Aconite root, ʒviij. Glycerin, fʒj. Alcohol, q. s.	Percolated, evaporated to fʒviij.
Liniment. plumbi subacet.	Ol. olivæ, ʒiij. Liq. plumbi subacet. ʒij.	Sedative.

Remarks on the Liniments.

Volatile liniment is a powerful stimulant, much used as a counter-irritant in sore throats, and also in rheumatism.

Lime liniment is applied with the most happy effects to recent scalds and burns; it is one of the most useful of preparations in the apothecaries' daily routine of minor surgery.

Soap liniment is a useful application for similar purposes with

volatile liniment, but less active; it is also readily removed by washing, containing no oil which is not saponified.

Opodeldoc, formerly officinal under the name of Linimentum Saponis Camphorata, but dismissed from the later editions, is used as an application to sprains, rheumatic pains, etc.; it is put up in small wide-mouth vials, into which the finger is inserted, to soften and extract it, and differs from officinal soap liniment chiefly in being made from animal oil soap, which thickens into a soft mass when it cools.

Liniment of Spanish flies, though usually applied as a local irritant and rubefacient, is capable of use as a vesicant, being applied on lint, and covered to confine its vapor.

Camphor liniment is well adapted as a vehicle of many substances applied in the form of stimulating liniment; it is well combined with aq. ammoniæ, as in Linim. Ammoniæ Camphorata, p. 883.

Kentish's ointment, though so different from lime liniment, is used in nearly the same cases; it is applied to recent burns, until the peculiar inflammation, called "the fire," subsides.

Working Formulas for the Liniments.

Linimentum Aconiti, U. S. P. (*Aconite Liniment.*)

Take of Aconite root, in fine powder, eight troyounces.
Glycerin, a fluidounce.
Alcohol, a sufficient quantity.

Moisten the powder with four fluidounces of alcohol and let it macerate for twenty-four hours, then pack it in a conical percolator, and gradually pour alcohol upon it until two pints of tincture have been obtained. Distil off a pint and a half of alcohol, and evaporate the remainder until it measures seven fluidounces; to this add the glycerin and mix thoroughly.

This tincture is designed to supply the place of ointment of aconitia, and is best used by saturating a piece of lint of the desired size with the liniment, and, after applying it to the part affected, covering it with a piece of oiled silk a little larger than the lint. It must be used with care, and not over an abraded surface.

Linimentum Ammoniæ, U. S. P. (*Volatile Liniment.*)

Take of Water of ammonia, a fluidounce.
Olive oil, two troyounces.
Mix them.

Linimentum Calcis, U. S. P. (*Lime Liniment.*)

Take of Solution of lime, eight fluidounces.
Flaxseed oil, seven troyounces.

Mix them.

Linimentum Camphoræ, U. S. P. (*Liniment of Camphor.*)

Take of Camphor, three troyounces.
Olive oil, twelve troyounces.

Dissolve the camphor in the oil.

Linimentum Cantharidis, U. S. P. (*Liniment of Cantharides.*)

Take of Cantharides, in fine powder, a troyounce.
Oil of turpentine, half a pint.

Digest the cantharides with the oil for three hours in a close vessel, by means of a water-bath, and strain.

Linimentum Chloroformi, U. S. P. (*Liniment of Chloroform.*)

Take of Purified chloroform, three troyounces.
Olive oil, four troyounces.

Mix them.

Linimentum Saponis, U. S. P. (*Soap Liniment.*)

Tinctura Saponis Camphorata, *Pharm.* 1850.

Take of Soap, in shavings, four troyounces.
Camphor, two troyounces.
Oil of rosemary, half a fluidounce.
Water, six fluidounces.
Alcohol, two pints.

Mix the alcohol and water, digest the soap with the mixture, by means of water-bath, until it has dissolved; then filter, and, having added the camphor and oil, mix the whole thoroughly together.

Linimentum Terebinthinæ, U. S. P. (Kentish's Ointment.)

Take of Resin cerate, twelve troyounces.
Oil of turpentine, half a pint.

Add the oil to the cerate previously melted, and mix them.

Linimentum Plumbi Subacetatis, U. S. P.

Take of Olive oil . . . . . ℥iij.
Liq. plumbi subacet. . . . . ℥ij.

Mix them.

Unofficinal Liniments.

Linimentum Ammoniæ Camphorata.

Take of Camphor liniment . . . . . 2 parts.
Water of ammonia . . . . . 1 part.

Mix.

An improvement on volatile liniment, having the additional advantage of camphor.

Liniment Prescribed in Catarrhal Croup.

Take of Camphor . . . . . ʒij, ℈ij.
Oil of turpentine . . . . . f ℥j.

Make a solution.

Liniment of Tannin.

Take of Tannic acid. . . . . ℥j.
Glycerin . . . . . f ℥j.

Make a solution.

This is adapted to the treatment of sore nipples and engorgements of the neck of the uterus; it may be diluted with water at pleasure.

Linimentum Plumbi Subacetatis.

Take of Solution of subacetate of lead,
Glycerin, of each . . . . . f ℥j.

Mix.

This is designed to enable the physician to apply subacetate of lead in a concentrated form, and to facilitate its dilution with neutral liquids, without its becoming so readily decomposed.

Linimentum Hyperici. (*Red Oil.*)

Take of Flower of hypericum (fresh), a convenient quantity.
Olive oil, sufficient to cover it.

Macerate in the sun for fourteen days, express and strain.

A well-known and popular application to recent bruises and sprains.

The flowers of hypericum (St. John's wort) are also used internally in the form of tincture and infusion.

Milk of Roses for Chapped Hands, etc.

Take of Almonds, blanched	℥j.
Rose-water	f ℥viij.
White wax	℥j.
Almond oil	℥ij.
White Castile soap	℥j.
Honey	℥ij.
Cologne	f ℥j.
Oil of bitter almond	gtt. iv.
Oil of rose geranium	gtt. v.
Glycerin	f ℥ss.

Blanch the almonds and beat to a paste, adding the rose-water, heat this to about 212° and incorporate with the white wax, almond oil, and soap, melted together, then add the other ingredients.

Directions.—After washing the hands with warm water and Castile or palm soap, apply the milk of roses, rubbing it thoroughly in, then wipe the hands with a dry towel.

Arnica Liniment. (*Glycerole of Arnica.*)

Take of Arnica flowers, bruised	4 ounces.
Glycerin	1 pound.

Digest at a moderate temperature on a water-bath, express and strain, or preferably, with Smith's steam displacer, displace the glycerin by steam pressure.

For this preparation, the cheap, impure glycerin of commerce answers an excellent purpose.

Linimentum Sulphuris.

Take of Sulphur. præcip.,
Almond oil,
Lime-water.

Triturate the sulphur with the oil, and add lime-water in slight

excess; shake it thoroughly together, and dispense in a wide-mouth vial.

This is designed as an improvement on sulphur ointment.

Glycerin Lotion.

Take of Rose-water	1 pint.
Quince seed	2 drachms.

Macerate, strain, and add—

Glycerin	1 ℔.

This is an elegant application to chapped hands, and may do very well for a hair dressing. Orange-flower water or other aqueous perfume may be substituted for rose-water.

Liniment of Iodide of Potassium.

Take of Common soap	℥j, ʒvj.
Alcohol	f ℥viijss.
Iodide of potassium	℥iss.
Water	f ℥iss.
Oil of garden lavender	ʒss.

Dissolve the soap in the alcohol by means of a gentle heat, and filter if it is not perfectly transparent; then add the oil of lavender and the iodide of potassium dissolved in the water, mix, and bottle while warm.

The strength of this liniment is about one drachm to the ounce.

Gelatinized Chloroform.

Take of Chloroform,	
White of egg, each	f ʒvj.

Put them into a wide-mouth two-ounce vial, shake it, and allow it to stand for three hours.

This is applied as a local anæsthetic with remarkable success.

CHAPTER VII.

PLASTERS, PLASMATA, AND CATAPLASMS.

Emplastra. (Plasters.)

These are external applications of a consistence thicker than cerates, and of such tenacity and adhesiveness at the temperature of the body that when warmed and applied they will adhere firmly. They are used for two principal objects: 1st, to furnish mechanical support and to protect the part from the air; and, 2d, to convey medicinal effects, especially of a stimulant and discutient character.

In the chapter on Fixed Oils, the subject of the preparation and properties of lead plaster, oleo-margarate of lead, is fully presented.

This preparation is the basis of most plasters, though many are made from resinous substances, which are treated of under the appropriate head on pages 422 to 429.

In accordance with the general plan of this work, a syllabus is presented embracing the composition of the officinal plasters, and remarks upon them, and the working formulas from the *Pharmacopœia* are appended with selections from unofficial formulas. Some practical directions for their preparation and the mode of spreading them follow.

EMPLASTRA.—*Syllabus of Officinal Plasters.*

Emp. plumbi.	(See page 386.) Diachylon plaster	
Emp. resinæ.	1 part p. resin. 6 parts lead plaster.	Adhesive plaster.
Emp. saponis.	1 part soap. 9 parts lead plaster.	Very mild and less adhesive.
Emp. aconiti.	1 oz. powdered aconite root, exhausted with alcohol. 1 oz. resin plaster.	Anodyne in neuralgia.
Emp. belladonnæ.	1 part alc. extract. 2 parts resin plaster.	Anodyne in neuralgia, etc.
Emp. opii.	1 part ext. opium. 3 parts B. pitch. 12 parts lead plaster.	Anodyne.
Emp. assafœtidæ.	2 parts assafœtida. 2 parts lead plaster. 1 part galbanum. 1 part yellow wax.	Antispasmodic.
Emp. galbani comp.	8 parts galbanum. 1 part turpentine. 3 parts B. pitch. 36 parts lead plaster.	Stimulant; antispasmodic.
Emp. hydrargyri.	3 parts mercury. 1 part olive oil. 1 part resin. 6 parts lead plaster.	Discutient; alterative.
Emp. ammoniaci.	G. resin, purified by diluted acetic acid.	Stimulant; resolvent.
Emp. ammoniaci cum hydrarg.	Ammoniac ℔j. Mercury ʒiij. Olive oil ℥j. Sulphur gr. viij.	Discutient; stimulant.
Emp. ferri.	1 part $Fe_2O_3 + Fe_2CO_3$. 8 parts lead plaster. 2 parts B. pitch.	Red strengthening, roborant plaster.
Emp. picis Burgundicæ.	12 parts B. pitch. 1 part yellow wax.	Strengthening; rubefacient.
Emp. picis canadensis.	12 parts Canad. pitch. 1 part yellow wax.	Strengthening; rubefacient.
Emp. arnicæ.	1 part alc. ext. arnica. 2 parts resin plaster.	Stimulant; roborant.
Emp. picis cum canth.	7 parts B. pitch. 1 part cerat. canth.	Warming plaster.
Emp. antimonii.	1 part tart. antimony. 4 parts B. pitch.	Counter-irritant, producing "pustulation."

REMARKS ON THE OFFICINAL PLASTERS.

Lead plaster associated with soap is rendered less adhesive and more bland in its characters, furnishing an emollient preparation, *Soap plaster*, often confounded with soap cerate.

By mixing with resin, lead plaster is rendered more adhesive, and somewhat more irritating; this is *Resin plaster*, a very familiar preparation, and, when spread on cotton cloth, constitutes *Adhesive plaster cloth.* Some elegant plaster cloths are also prepared in which this excellent "body" is incorporated with mercury, belladonna, opium, etc., and spread upon cotton, linen, or silk fabrics.

These should be kept in tin cans, and, when disposed to crackle, should be held to the fire till fused on the surface, and then laid away to cool thoroughly before being again rolled up.

The skilful association of the medicinal substances prescribed in the officinal plasters, is accomplished mainly by fusion and stirring together. *Belladonna* and *Aconite plasters* are made by incorporating the alcoholic extracts with resin and lead plaster, the extracts being softened and added as the plasters thicken by cooling. *Opium plaster* by the direction of the last *Pharmacopœia* is made from aqueous extract of opium.

In *Mercurial plaster* the globules of mercury are extinguished by the use of resin, and in *Plaster of ammoniac* with *mercury* a little sulphur and oil are used to extinguish the mercury before associating it with the ammoniac.

Ammoniac plaster is peculiar in its mode of preparation; it consists of the pure gum-resin as dissolved in vinegar, strained and evaporated. *Assafœtida* and other imperfectly soluble gum-resins are purified by solution in alcohol, and evaporation to bring them to a suitable condition for incorporation into this form. A small proportion of these plasters sold by manufacturers come up to the officinal standard.

Working Formulas from the Pharmacopœia.

Emplastrum Resinæ, U. S. P. (*Adhesive Plaster.*)

Take of Resin, in fine powder, six troyounces.
Lead plaster, thirty-six troyounces.

To the plaster, melted over a gentle fire, add the resin, and mix them.

Emplastrum Saponis, U. S. P. (*Soap Plaster.*)

Take of Soap, sliced, four troyounces.
Lead plaster, thirty-six troyounces.
Water, a sufficient quantity.

Rub the soap with water until brought to a semiliquid state; then mix it with the plaster, previously melted, and boil to the proper consistence.

Emplastrum Aconiti.

Take of Aconite root, in fine powder, sixteen troyounces.
Alcohol,
Resin plaster, each, a sufficient quantity.

Moisten the aconite root with six fluidounces of alcohol, and pack in a conical percolator. Cover the surface with a disk of paper, and pour upon it ten fluidounces of alcohol. When the

liquid begins to drop from the percolator, close the lower orifice with a cork and set it aside for four days. Then remove the cork, and gradually pour on alcohol until two pints of tincture have been obtained, or the aconite root is exhausted. Distil off a pint and a half of alcohol by means of a water-bath, and evaporate the residue to the consistence of a soft uniform extract. Add to this sufficient resin plaster, previously melted, to make the mixture weigh sixteen troyounces, and then mix thoroughly.

Emplastrum Belladonnæ, U. S. P. (*Plaster of Belladonna.*)

Take of Belladonna root, in fine powder, sixteen troyounces.
Alcohol,
Resin plaster, each, a sufficient quantity.

Moisten the belladonna root with six fluidounces of alcohol, pack it in a conical percolator, and, having covered the surface with a disk of paper, pour on ten fluidounces of alcohol. When the liquid begins to drop from the percolator, close the lower orifice with a cork, and, having closely covered the percolator, set it aside for four days. Then remove the cork, and gradually pour on alcohol until two pints of tincture have slowly passed. Distil off by means of a water-bath a pint and a half of alcohol; introduce the residue into a two-pint capsule, and evaporate on a water-bath to a soft uniform extract; ascertain its weight, and, having added sufficient resin plaster, previously melted, to make the whole weigh sixteen troyounces, mix them thoroughly.

Emplastrum Galbani Compositum, U. S. P. (*Compound Plaster of Galbanum.*)

Take of Galbanum, eight troyounces.
Turpentine, a troyounce.
Burgundy pitch, three troyounces.
Lead plaster, thirty-six troyounces.

To the galbanum and turpentine, previously melted together and strained, add first the Burgundy pitch, and afterwards the plaster, melted over a gentle fire, and mix the whole together.

Emplastrum Hydrargyri, U. S. P. (*Plaster of Mercury.*)

Take of Mercury, six troyounces.
Olive oil,
Resin, each, two troyounces.
Lead plaster, twelve troyounces.

Melt the oil and resin together, and, when they have become cool, rub the mercury with them until globules of the metal cease to be visible. Then gradually add the plaster, previously melted, and mix the whole together.

Emplastrum Opii, U. S. P. (*Plaster of Opium.*)

Take of Extract of opium, a troyounce.
Burgundy pitch, three troyounces.
Lead plaster, twelve troyounces.
Water, a sufficient quantity.

Mix the extract with three fluidounces of water, and evaporate, by means of a water-bath, to a fluidounce and a half. Add this to the Burgundy pitch and plaster, melted together by means of a water-bath, and continue the heat for a short time, stirring constantly, that the moisture may be evaporated.

Emplastrum Ammoniaci, U. S. P. (*Plaster of Ammoniac.*)

Take of Ammoniac, five troyounces.
Diluted acetic acid, half a pint.

Dissolve the ammoniac in the diluted acetic acid, and strain; then evaporate the solution by means of a water-bath, stirring constantly, until it acquires the proper consistence.

Emplastrum Ammoniaci cum Hydrargyro, U. S. P. (*Plaster of Ammoniac with Mercury.*)

Take of Ammoniac, twelve troyounces.
Mercury, three troyounces.
Olive oil, sixty grains.
Sublimed sulphur, eight grains.

Heat the oil, and gradually add the sulphur, stirring constantly until they unite; then add the mercury, and triturate until globules of the metal cease to be visible. Boil the ammoniac with sufficient water to cover it, until they are thoroughly mixed; then strain through a hair sieve, and evaporate, by means of a water-bath, until a small portion taken from the vessel hardens on cooling. Lastly, add the ammoniac, while yet hot, gradually to the mixture of oil, sulphur, and mercury, and thoroughly incorporate all the ingredients.

Emplastrum Assafœtidæ, U. S. P. (*Plaster of Assafœtida.*)

Take of Assafœtida,
Lead plaster, each, twelve troyounces.
Galbanum,
Yellow wax, each, six troyounces.
Alcohol, three pints.

Dissolve the assafœtida and galbanum in the alcohol by means of a water-bath, strain the liquid while hot, and evaporate to the consistence of honey; then add the plaster and wax, previously melted together, stir the mixture well, and evaporate to the proper consistence.

Emplastrum Ferri, U. S. P. (*Strengthening Plaster.*)

Take of Subcarbonate of iron, three troyounces.
Lead plaster, twenty-four troyounces.
Burgundy pitch, six troyounces.

Add the subcarbonate of iron to the plaster and Burgundy pitch, previously melted together, and stir them constantly until the mixture thickens on cooling.

Emplastrum Picis Burgundicæ, U. S. P. (*Burgundy Pitch Plaster.*)

Take of Burgundy pitch, seventy-two troyounces.
Yellow wax, six troyounces.

Melt them together, strain, and stir constantly until they thicken on cooling.

Emplastrum Picis Canadensis, U. S. P. (*Hemlock Pitch Plaster.*)

Take of Canada pitch, seventy-two troyounces.
Yellow wax, six troyounces.

Melt them together, strain, and stir constantly until they thicken on cooling.

Emplastrum Arnicæ, U. S. P. (*Arnica Plaster.*)

Take of Alcoholic extract of arnica, a troyounce and a half.
Resin plaster, three troyounces.

Add the extract to the plaster, previously melted by means of a water-bath, and mix them.

Emplastrum Picis cum Cantharide, U. S. P. (*Warming Plaster.*)

Take of Burgundy pitch, forty-eight troyounces.
Cerate of cantharides, four troyounces.

Melt them together by means of a water-bath, and stir constantly until the mixture thickens on cooling.

Emplastrum Antimonii, U. S. P.

Take of Tartrate of antimony and potassium, in fine powder, a troyounce.
Burgundy pitch, four troyounces.

Melt the pitch by means of a water-bath, and strain; then add the powder, and stir them well together until the mixture thickens on cooling.

Tartar emetic, if precipitated by pouring its solution into alcohol, 95 per cent., is reduced to a very fine powder, which when dried is in the best condition for making ointment or plaster.

Unofficinal Plasters.

Logan's Plaster.

Take of Litharge,
Carbonate of lead, of each . . . . . 1 ℔ com.
Castile soap . . . . . 12 oz. com.
Fresh butter . . . . . 4 oz.
Olive oil . . . . . 2½ pints.
Powdered gum mastich . . . . . 2 drachms.

Mix the soap, oil, and butter together; then add the oxide of lead and boil it gently over a slow fire for an hour and a half, or until it has a pale brown color, stirring constantly; the heat may then be increased and the boiling continued, till a portion of the melted plaster being dropped on a smooth board is found not to adhere, then remove it from the fire and add the powdered gum mastich.

Emplastrum Universalis.

A plaster is officinal in several of the European *Pharmacopœias* under different names, which appears to be identical with Keyser's Universal plaster, sold extensively in this country as a nostrum.

The following is the formula of the Prussian *Pharmacopœia;* the proportions are by weight:—

Take of Red lead, in very fine powder	℥viij.
Olive oil	℥xvj.

Boil them in a proper vessel with constant agitation until the whole has assumed a blackish-brown color, then add—

Yellow wax	℥iv.

And after this has been melted and well mixed—

Camphor	ʒij.

Previously dissolved in a little olive oil.

Now pour it out into suitable boxes, or into paper capsules, to be cut into square cakes when cold.

Dewees' Breast Plaster. (*A Modified Formula.*)

Take of Lead plaster	℥iij.
Ammoniac plaster	℥ss.
Logan's plaster	℥iss.
Spermaceti,	
Camphor, of each	ʒij.

Melt the plasters, then add the spermaceti and camphor, and remove from the fire.

Pancoast's Sedative Plaster.

Take of Extract of belladonna,	
Mercurial plaster,	
Lead plaster	Equal parts.

Mix by fusion and trituration.

Plaster for Mammary Abscess. (Dr. Ellwood Wilson.)

Take of Belladonna plaster	1 part.
Logan's plaster	2 parts.

Melt them together and spread upon chamois leather. (See page 893.)

Spreading of Plasters.

Plasters are spread on skin of various kinds and finish, on cotton cloth of different qualities, and rarely on silk and paper; of those spread upon skin, the size is indicated in prescription, by the number of inches in each direction, or, when irregular shapes are ordered, by a pattern furnished the pharmacist.

The spreading of plasters, which was formerly an important part of the business of the apothecary, has now, like many other operations of his art, been monopolized by manufacturers, who, by making

this single branch of manufacture a specialty, acquire facility for the production of cheap and salable varieties. Machine-spread *strengthening plasters* are immensely popular outside the profession for a great variety of ailments, and they are undoubtedly better adapted to meet the public demand for cough remedies, and "pain eradicators," than the great majority of the "pectoral syrups," "hot drops," and anodynes, so extensively vended. Recently, the manufacturers have prepared specific kinds of plasters, and sold them under appropriate names as Burgundy pitch, hemlock, and warming plasters, so as to put them within the range of physicians' prescriptions. Some of them should make the series of officinal plasters in appropriate sizes and compounded of the best ingredients and strictly according to the *Pharmacopœia;* there would certainly be a demand for them, as apothecaries seldom covet the labor of preparing them extemporaneously.

In Prof. Procter's edition of Mohr and Redwood's Pharmacy, a machine for spreading the ordinary strengthening plasters is figured; it consists of a block of hard wood, about twelve inches long, eight inches wide, and three and a half inches high; the upper surface is curved from end to end, a tinned, iron, or steel frame cut out of the size and shape of the plaster to be spread is secured to the block by a hinge-joint, and when the end is brought down and fastened by hasps, it presses evenly and with force over the convex surface; a frame accompanies it for marking out the pattern on the leather, which is to be cut previously to being put on the machine.

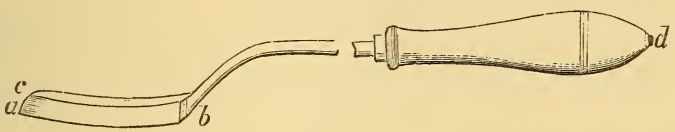
Another part of the apparatus is a bar of cast-steel an inch square, perfectly smooth, the ends drawn out and mounted with wooden handles; this is to be warmed gently by an alcohol lamp or by immersion in hot water previously to being used to smooth the surface of the plaster for which it is designed. The material, being melted in a copper skillet, is poured on the skin, properly secured on the curved surface by the steel frame, and smoothed by the warmed smoothing iron till of uniform thickness, the excess of plaster being pushed on to the frame and afterwards removed; the plaster is then removed and laid away to harden. Skill in the use of this apparatus can only be acquired by experience; but the most obvious precautions in this, as in the case of extemporaneous plasters, depend on the proper regulation of the temperature, both of the melted plaster when poured on, and of the smoothing iron applied; if too hot, the skin will be penetrated and the plaster will show on the unspread side, besides in most instances being deteriorated; if not hot enough the plaster will be laid on too thickly, and with an unpolished surface.

Plasters to be spread extemporaneously of various sizes and patterns may be melted in a small metallic vessel over a gas or spirit lamp, and poured directly upon the skin, properly secured upon a flat surface, with several thicknesses of paper under it, then smoothed with a small plaster iron, moderately heated, or a large spatula, which skilfully managed answers equally well; or the plaster may be, as is perhaps more common, fused by the heat of

the plaster iron upon a piece of stout paper, transferred from this to the skin, and then smoothed by the gradually cooling iron.

Figs. 248 and 249 show plaster irons of the kinds adapted to different sizes and kinds of plasters, the larger sizes being suitable

Fig. 248.



to spread a large plaster of slowly fusible material. When the heat necessary to melt the plaster is derived from the iron, it should be first warmed to such temperature that, while it will occasion the plaster to flow, it will not scorch it. The iron should also retain sufficient heat, till the operation is complete, to impart a smooth surface to the stiffened plaster. The small iron will do well to spread a warming plaster, belladonna plaster, or the similar easily fusible kinds.

Fig. 249.

The pattern of the plaster is usually cut out of a piece of smooth, stiff hardware paper, which is then pasted on to the skin with a good deal of flour or tragacanth paste, so that it shall not dry and adhere too firmly to the skin before its removal is allowable. When the plaster is properly smoothed over the leather, the paper pattern is torn up, and leaves a clean neat edge of the prescribed shape; where the material is brittle, it may be requisite that the warm plaster iron should be passed around the edge while removing the paper pattern. The margin of plasters should be at least half an inch wide where the material is very fusible and adhesive, thus saving much annoyance to those requiring to use them; in a few instances, however, as in the case of soap plasters to be applied to bed sores, any required extent of the skin may be spread, and portions of the required size and shape may be cut off as needed; this plaster, not being liable to "run," requires no margin.

The material on which plasters are spread may be varied according to their use. Resinous plasters or warming plasters to be applied to the back or breast, as counter-irritants and mechanical supports, are spread on thick sheepskin, while opium and belladonna plasters, which are generally smaller and frequently applied about the face, may be spread on kid, split skin, or cotton cloth, and if they have precisely the consistence proper for this kind of application, they are less cumbrous and disagreeable than those spread on kid. I have found advantage in spreading the large circular plasters to be applied over the breast of the female on the kind of skin called

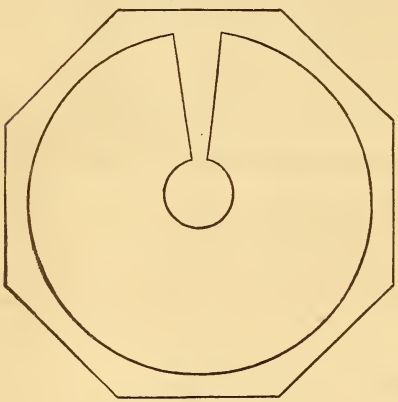
"*chamois*," which is more flexible and yielding, though equally durable with the differently dressed "sheepskin."

Breast Plasters.—The frequent demand for stimulating, emollient, and sedative applications to the mammæ of females, as preventives or remedies for mammary abscess, has given rise to several combinations, described on page 891; it now remains to indicate a suitable pattern for this kind of plaster.

The usual shape prescribed is that of a circle, about 8 inches in diameter, with a hole in the middle; the diameter should be varied with the size of the mammæ, and the hole should in no case be less than an inch in diameter, so as to allow ample room for the nipple to project and even for the infant to be nursed if required.

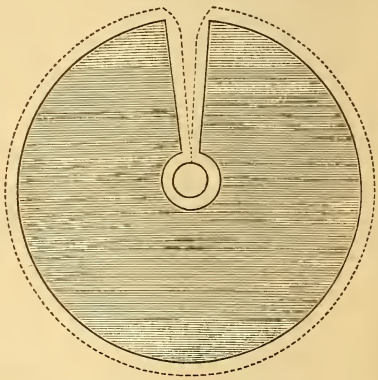
In order to supply these to physicians in distant localities, who have not facilities for spreading them or ready resort to competent pharmacists, I have made the pattern shown in the drawings. The diameter of the spread plaster is 7 inches, the margin 1 inch, the orifice for the nipple is placed nearer to one side, in conformity with the shape of the enlarged mammæ, and the fact that the hardness is apt to be on the under, swagging portion. This hole has the diameter of 1½ inch, besides a very narrow margin. The strip remaining unspread is designed to be cut open on the dotted lines, Fig. 251, adapting the plaster to the curved shape of the breast and to breasts of different sizes. The pattern of tinned iron, Fig. 250, is designed to be tacked over the smooth skin to facilitate the

Fig. 250.



Pattern for breast plaster.

Fig. 251.



Mammary abscess plaster.

spreading of these plasters, which are of various materials, the most highly esteemed composition being that given on page 891, as recommended by Dr. Ellwood Wilson. In some cases the simple Logan's plaster is spread, for others tobacco ointment, and for others Deshler's salve. The plasters proper are best spread on *chamois skin*, but ointments and cerates will, perhaps, do better on highly glazed cotton cloth, which, as it is less elastic and flexible

than the skin, may require to be somewhat nicked to adapt it to the convex surface for which it is designed.

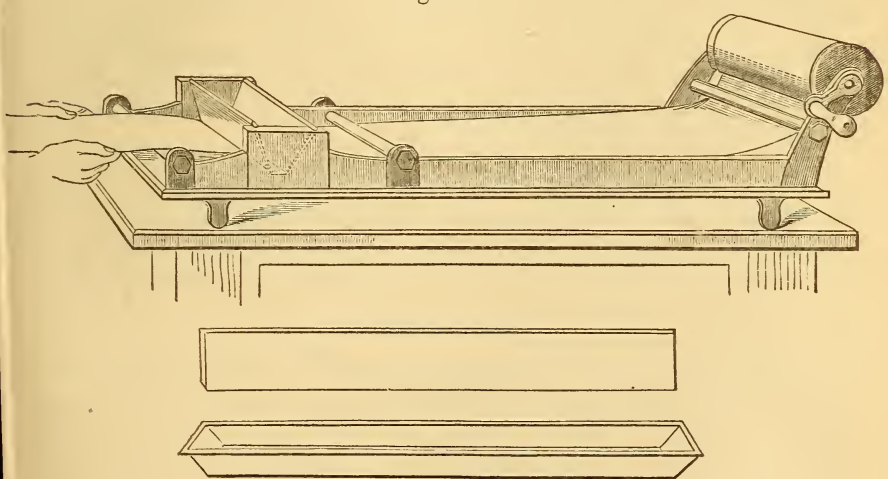
Annular Corn-Plasters.—Under this name is prepared a very convenient application to corns. Adhesive plaster is spread on *thick buckskin*, and then, with a punch, cut into small round plasters, about $\frac{5}{8}$ inch in diameter, then with another punch a small hole is cut in the middle. Applied over a sore corn, it protects from the pressure of the shoe and gives great relief.

White felt and *amidou plasters*, imported from England, have the same shape and general character of these; they consist of a gelatinous preparation, similar to that used in making court-plaster, spread upon peculiar thick material of great softness and elasticity.

Plaster Cloth.—The method of spreading plaster on muslin or cotton cloth, for sale by the yard, requires the use of peculiar apparatus, which is kept with great secrecy by the few manufacturers who possess them, and I do not know of their being heretofore figured in works on pharmacy. This material is not so well adapted as sheepskin to plasters which require to be spread thickly or which are very volatile or easily deteriorated by exposure; it has been, until recently, employed almost exclusively in spreading adhesive plaster for the surgeon and for popular use.

Since procuring the apparatus shown in Fig. 252 I have used it for belladonna and mercurial plasters, and find it applicable to almost any of the kinds having lead plaster as a basis, which from their convenience of application and comparative cheapness, when spread in this way, are well adapted to popular employment.

Fig. 252.



Machine for spreading plaster cloths.

The frame of this machine is of cast iron; its construction will be obvious from a study of the drawing; the cotton cloth is wound tightly on to the roller on the extreme right, by the aid of the

crank and passed under the iron rod beneath, and is thence drawn by a gentle and uniform motion under the receptacle for the plaster which is shown near the left end of the machine; this consists of a marble slab at bottom, and two movable heavy steel knives fitting into grooves in the ends, and pressing by their weight upon the cloth passing under them; this pressure is designed to be so adjusted as to occasion the proper thickness of plaster to be left smoothly deposited upon the cloth as it is drawn from under them; this thickness will also be much influenced by the heat and consequent fluidity of the melted plaster. One of the steel knives is shown in the lower figure, removed from its position, with the tin vessel in which it is designed to be warmed by the application of hot water previous to being used.

The muslin selected for spreading must be first "calendered," a process of smoothing between hot rollers which gives it a perfectly smooth and close surface, and prevents the melted plaster from being too much absorbed. The art of using the machine consists in securing the proper degree of smoothness and fluidity of the plaster, upon which the thickness of the coat left upon the cloth will depend, and in the steadiness with which the cloth is drawn through the machine. Any irregularity in this motion will occasion variations in the thickness and a streaked appearance across the plaster; variations are produced longitudinally by any deflection or irregularity of surface of the scraping and smoothing irons, or by any solid particles present in the melted plaster. On the whole, it appears to be the conclusion of all who attempt the spreading of plaster cloth, that the operation is too difficult to justify any in undertaking it whose demand for the plaster will not be such as to make it a frequent operation. Probably those who practise plaster spreading on a large scale have expedients for regulating the flow of the melted plaster, the pressure of the smoothing irons, and the steady movement of cloth, which are not present in the machine above described.

A description of plaster-cloth is imported from England under the name of doeskin, the tissue of which is much thicker and has a nap on the unspread surface; it is not unlike canton flannel. Its superiority consists in its greater body and thickness, adapting it to some applications to which ordinary muslin is less suited.

Plasmata.*

Under the name of glyceroles, glycamils, and plasmata, some unofficinal preparations of the consistence of pomades have been introduced into medicine within a few years. They are made by heating starch and glycerin together; the glycerin may be previously medicated, and the preparation thus adapted to therapeutical applications, or medicinal substances in powder may be incorporated mechanically with the starch, and thus suspended in the preparation. They do not vary with changes of temperature as

* See Pharm. Journ. and Trans., Feb. 1858, and Amer. Journ. Pharm., 1858, p. 252.

ointments do, and are not liable to become rancid or change in their chemical composition, though their consistence becomes thinner by time. The following are introduced as among the most useful formulas of this class:—

Plasma. (G. F. Schacht.)

Take of Glycerin, one fluidounce.
Starch, in powder, seventy grains.

Mix the powdered starch with the glycerin and gradually heat the mixture to about 240°, constantly stirring.

This constitutes a basis from which may be produced preparations corresponding with most of the cerates and ointments of the *Pharmacopœia.*

Plasma of Tar. (Glycerole de Goudron.)

Take of Glycerin, one ounce.
Purified tar, half a drachm.
Powdered starch, half an ounce.

Heat the starch with the glycerin and tar, stirring them together.

This application is recommended as an astringent and resolvent, without producing irritation; it allays itching, dries up excoriations, and dissipates cutaneous phlegmasiæ.

Plasma Belladonnæ. (London Ophthal. Hospital.*)

Take of Extract of belladonna	30 grains.
Glycerin	1 ounce.
Starch	1 drachm.

Make a plasma *secundum artem.*

Plasma Plumbi. (C. S. Tilyard.)

Take of Glycerin, two fluidounces.
Sol. subacetate of lead, three fluidrachms.
Camphor, ten grains.
Bermuda arrowroot, one and a half drachm.

Rub the arrowroot into a fine powder, and having mixed the glycerin and extract of lead, stir it into the mixture. Pour the whole into a capsule and heat over a spirit lamp cautiously, constantly stirring until it becomes transparent, and assumes the consistence of paste. Having powdered the camphor by means of a few drops of alcohol, rub a little of the plasma with it in a mortar until well incorporated, then add the remainder and stir a few minutes.

When first made it is viscid and ropy, but in a day or two loses these properties and becomes at the ordinary temperature (say 60° F.) of the consistence of soft ointment.

* From Squire's Pharmacopœia of the London Hospitals.

Glycamyl Sinapis. (M. Grimault.)

Take of Glycerin	13 drachms.
Starch	2 drachms.
Volatile oil of mustard	80 drops.

Mix them by the aid of heat.

This preparation is designed as an extemporaneous sinapism; it is an elegant though costly substitute.

Glycerin Pomade of Iodide of Potassium. (M. Thirault.)

Take of Glycerin	1000 parts.
Almond soap	50 parts.
Powd. iodide of potassium	130 parts.

Dissolve in a water-bath, pour immediately into a warm mortar and triturate briskly for a quarter of an hour. It may be aromatized at pleasure.

It is a permanent preparation; the iodine salt is in solution and in a favorable condition for absorption. It neither colors the skin nor the linen.

Basis for Topical Application. (M. Startin.)

Take of Gum tragacanth	½ ounce.
Glycerin	1 ounce.
Lime-water	2 ounces.
Rose-water, sufficient to form a soft jelly.	

This is an elegant material, said to be less deliquescent than the *Plasma* of Schacht.

Glycerinum Amyli, Ph. Br.

Take of Starch, one ounce avoir.
Glycerin, eight fluidounces imp.

Rub together in a mortar until intimately mixed and then transfer to a porcelain capsule, heat to 250°, stirring constantly till the starch particles are broken and a perfectly smooth jelly is formed.

This is practically the same as the plasma introduced by Mr. Schacht, noticed a few pages back.

Cataplasms.

The following is introduced as a specimen of the unofficinal class of cataplasms, to which mustard plaster and the numerous varieties of poultices belong.

Cataplasma Lini. (*Flaxseed Poultice.*)

Take of Flaxseed meal, four ounces.
Boiling water, sufficient.

Stir them together into a suitable mass.

The oil existing naturally in the flaxseed meal serves to render this a very emollient application. Some physicians prefer a mixture of flaxseed meal with cake meal (from which the oil has been extracted) for the purpose.

Cataplasma Sinapis. (*Mustard Plaster or Sinapism.*)

Take of Mustard flour, four ounces.
Wheat or rye flour, three ounces.
Boiling water, half a pint, or sufficient.

Stir the whole into a soft mass upon a suitable dish.

The strength of the sinapism is varied by changing the relative proportions of the ingredients. For children there should be about half the proportion of mustard. Care should be taken to remove it before a blister is created.

Spice Plaster. (Dr. Parrish, Sen.)

Take of Powd. capsicum,
Powd. cinnamon,
Powd. cloves, each . . . . . 2 ounces.
Rye meal,
Spirits,
Honey, of each . . . . . Sufficient.

To be made into a cataplasm by trituration on a plate, and spreading upon a close fabric. It should be made up extemporaneously when required.

CHAPTER VIII.

ON DISPENSING AND COMPOUNDING PRESCRIPTIONS.

All the processes described in the previous practical parts of this work are subservient to the important operations of supplying or administering remedial agents to the public, called dispensing, and the art of compounding extemporaneous prescriptions of physicians.

The formulas given in the last chapter have been introduced mainly with a view to acquainting the physician and pharmacist with the best forms for combining the leading remedies; the act of compounding these is a difficult branch of knowledge, only acquired by an habitual training of the faculties of observation and reflection, and the attainment of a certain manual dexterity and expertness of manipulation, of more or less importance in every practical pursuit, and indispensable in this.

The ordinary process of handing out medicines to the applicants over the counter involves responsibilities connected with no other branch of the trade, and calls for the exercise of constant vigilance to guard against the least thoughtlessness or inattention, and to fortify the mind against the many distracting influences constantly present in a place of business. To these must be added occasional vexatious evidences of ignorance or carelessness on the part of physicians, to overcome which, the pharmacist must tax the utmost resources of his art, while many evidences of ignorance, prejudice,

and perversity on the part of his customers and his rivals in business, call for all his patience, self-control, and conscientiousness.

It is thus apparent that the subject of this chapter constitutes the most difficult practical branch of pharmacy, for, in addition to the variety and extent of knowledge required for the performance of the various duties involved in it, a salesman and dispenser of medicines must possess rare personal qualities to render him popular and successful in his calling.

Neatness, agility, and readiness of manner, combined with uniform watchfulness and care in all the important manipulations required of him, will inspire confidence, and secure patronage; while slothfulness, negligence, and indifference to what may seem petty details, will invariably inure to the disadvantage of their possessor. As the art of dispensing can only be acquired by practical experience at the counter, its numerous and varied details cannot be taught by books. Authors when treating of this subject in a truly useful way can at best only lay down general rules, and set forth leading principles in regard to what must become the subject of daily experience.

In the hints which are here offered, I have chiefly in view the country practitioner, whose necessities compel him to undertake the business of dispensing and compounding, and the *student* of medicine and pharmacy, who would seek to obtain from books the leading topics on which to found his practical and experimental routine of studies.

The Furniture of the Physician's Dispensing Office.

In the first preliminary chapter, most of the forms of apparatus required by the country practitioner in dispensing were described and fully illustrated, and in the succeeding parts of the work, many useful implements, chiefly employed in manufacturing processes, have been introduced in connection with their uses and modes of construction; a few will be illustrated along with the manipulations yet to be treated upon. It will be observed that many of these forms of apparatus are by no means indispensable, and that all the processes described throughout the work can be performed with but few and cheap implements.

The *dispensing office* should have a counter of size proportioned to its anticipated use, with a closet in it, and a few drawers; it should be placed very near to the bottles containing the medicines. The physician will require no more than a table of perhaps six or eight feet long, unless his dispensing business exceeds the requirements of his own medical and surgical practice, but this should be made of about three feet in height, solid, and with a heavy top of hard wood, or otherwise covered with oil cloth.

The counter should contain a pair of large scales and the prescription scales and case, which, however, should be so placed as not to be jarred by the contusion of substances with the pestle and mortar, and may very appropriately be placed on an adjacent shelf

or table appropriated exclusively to them, and quite within reach in manipulating at the counter.

A closet or shelves under the counter may be appropriated to mortars and pestles, funnel, etc.; one shallow drawer with divisions should be appropriated to papers, cut for dispensing, as below described; another to labels, pill boxes, powder boxes, corks, scissors, etc., each in a separate apartment; another may contain the pill machine and tile, the spatulas, and plaster iron; a place must be appropriated to a towel, and a tank, or, preferably, a hydrant with a sink should be near at hand; a few deep drawers will be found useful for containing the drugs bought in packages, and for which no bottles are provided.

On the top of the counter, the cork presser, the twine reel, and the alcohol lamp and graduated measure, may be appropriate ornaments. If practicable to have another counter for small manufacturing operations, it would be well to avoid cumbering the dispensing counter with a gas furnace, but otherwise the arrangements described in part second will be convenient; gas may be led by a flexible tube from the pendant or side-light nearest at hand, and will be very convenient for heating purposes. It is well to have immediately under the top of the dispensing counter, two slides, on which most of the manipulations are performed; one of these should be kept exclusively for powders, and the other used indiscriminately, to save the top from being soiled.

The stock of medicines should be arranged in a case, or on shelves, within a few feet of the counter. In the appendix will be found the dimensions necessary for the outfits there published. The shelves should be somewhat more extended than the actual dimensions required at first, to allow for additions from time to time, and care should be taken in making these additions to have the glassware correspond with the original stock. In the first preliminary chapter, the whole subject of glassware and tin boxes is fully considered.

The books of reference, which should be ample—and if the proprietor himself, and those under his instructions, would keep pace with the advance of the times, should include the *American Journal of Pharmacy*, and *American Druggist's Circular*, bound from year to year—should be in a neighboring case; this might be advantageously arranged to contain also a skeleton, and the surgical, dental, and obstetric instruments, bandages, splints, etc. The bougies and catheters should be in a tin case, so also the adhesive plaster, blistering tissue, gum-elastic bougies, nipple shields, etc.

It is to be regretted that the proper arrangement and garnishing of the dispensing office should be generally considered of so little importance by practitioners at the commencement of their career; it is apt to have more effect upon the future success of the physician than he can appreciate in advance.

There is a difference of sentiment and a varying practice in regard to compounding prescriptions, behind a case or screen, or in full

view of customers; the practice has gained ground of latter years of conducting all the operations of compounding at a screened counter, and holding intercourse with the customers only at the time of receiving the prescription and handing out the preparation. Although it has been observed that where this is the practice there is often less care bestowed upon the cleanliness and nicety of the operation, than where the whole is subjected to the scrutiny of a customer, who, though perhaps no pharmacist, may be a critical observer of the neatness and expertness of manipulations; yet this should not permit the proprietor of any pharmaceutical establishment from taking this very important method of preventing this most common cause of accident, conversation while engaged in compounding remedies. Too much care can hardly be bestowed upon the accuracy of the weighings and the completeness of the admixture of the ingredients prescribed, and the circumstances attending their being compounded and dispensed should all be calculated to carry out the instructions of the physician and to win the confidence of the patient and his friends.

Dispensing.

The peculiar qualities and great variety of the drugs and preparations called for by his customers require of the dispenser of medicines considerable experience and aptness to understand the numerous inquiries, besides a retentive memory to recall the localities of the different, and sometimes rare, articles in his shop, with their cost and selling price.

This difficulty is increased by the fact that ignorant people and children often apply to him for medicines, the names of which are only imperfectly known to them, and he is compelled to form a notion of their requirements after a series of questions, which may or may not be skilfully put and cheerfully answered.

Every dispenser of medicines, and especially every young man who has yet to win a reputation, should cultivate habits of politeness and deference, even to the poor and ignorant, and to aid him in this let him remember how little opportunity the public generally have had to acquaint themselves with drugs, which were for so many centuries wrapped in an obscure nomenclature, and considered as falling within the special province of a single profession, priding themselves upon the secrecy and even mystery of their craft. This reflection should also induce the pharmacist to seek occasions in the course of his daily contact with the public to interest inquiring minds in the commercial, botanical, and chemical history of the articles he dispenses, and to explain their uses, and even in conversation with the least intelligent to remove the rough edge of their ignorance, by well-directed remarks and explanations. This course is not only useful to the customer but serves to interest and improve the dispenser, and to raise him in the esteem of those, the meanest of whom may have it in their power to add to or detract from his reputation and his business.

One of the most common annoyances to the apothecary arises from the idea, which not unfrequently finds expression, that he is charging an undue profit upon his articles; this is a natural conclusion in the mind of the purchaser of drugs from their wide difference between the relative prices charged for small and larger quantities. Many answers to comments on his prices will suggest themselves to the ingenious salesman, but to make these conclusive he must show by the precision and judgment with which he conducts his business, and by the neatness and exactness which he brings to bear upon every little package he sends out, that he regards his vocation not as a common trade, merely to buy and sell and get gain, but that as a man of science and a careful conservator of the interests of his customer, as well as his own, he amply earns all the pecuniary advantages which his business is supposed to bring.

Dispensing of Solids.

The business of dispensing involves the manipulation of weighing, measuring, wrapping, and labelling. These require little description or comment here. The usual practice with pharmacists is to weigh all solid articles upon the paper in which they are to be wrapped, and where great nicety is required, as in the case of very costly articles, to balance the paper with a piece of like size upon the opposite dish of the scales. Avoirdupois weights are used in all ordinary dispensing operations. Some liquids which would soil a graduated measure, such as copaiva, Venice turpentine, Canada balsam, and the fixed oils, are usually weighed in the vessel in which they are to be dispensed; this may be a bottle, gallipot, ointment box, tumbler, or other convenient vessel with a wide mouth; in other cases the quantity is conveniently determined by the size of the vial, the retail prices of liquids being usually graduated according to their liquid measure.

Folding and Dispensing of Powders.—The first operation taught students in the school of practical pharmacy is this; there are thousands who have felt the want of such instruction all their lives.

The paper usually purchased for folding packages of medicine is called "white druggists' wrapping paper;" its size is called double medium, each sheet being about $38 \times 24\frac{1}{2}$ inches. This sheet cut into 2 sheets $24\frac{1}{2} \times 19 =$ the *medium* size. The thickness of the paper is quite important; a flimsy paper renders it almost impossible to make neat packages, and as the thickness of paper is determined greatly by its weight, the proper thickness is that of paper of 45 to 50 lbs. per ream. The medium sheet is thus conveniently divided for dispensing purposes:—

Into	4	sheets	$12 \times 9\frac{1}{2}$	inches suitable for	$\frac{1}{2}$ ℔ papers.
	6	"	$9\frac{1}{2} \times 8$	" "	$\frac{1}{4}$ ℔ papers.
	12	"	$6\frac{1}{4} \times 6\frac{1}{4}$	" "	1 oz. papers.

Fig. 253 shows a $\frac{1}{4}$ ℔ paper. To fold a package, this is laid upon the scale dish and filled with an appropriate quantity; of a moder-

Fig. 253.

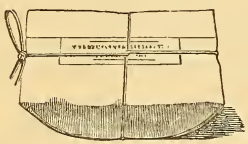
Paper for packages.

ately heavy article, like Epsom salts or cream of tartar, this will be 4 oz.; of a light article, like senna or chamomile, say 1 oz. The paper is placed before the operator in the direction here shown; a little crease is made on the nearest end so as to form a flap into which the furthest edge is fitted, and the whole turned over upon the containing substance so as to form a crease when laid evenly down upon it, at the middle or near the further side, according as a wide or narrow bundle is desired.

The oval cylinder is now loosely closed up at one end by turning it over, and is held up with the crease towards the operator, the thumb pressing it firmly to prevent its bulging. Now, with the forefinger, the upper end of the cylinder is pressed in against the containing substance, and the two sides of the paper being rolled into the position they naturally take, the whole upper flap is laid down immediately above the containing substance and pressed into a firm and even crease. The package is now inverted, the other end is opened out, rolled in, and folded over in like manner.

The next operation is to label the package; this requires very little paste, only sufficient should be applied to prevent its slipping about; the label is put immediately in line with the crease, unless this is too low down, and then it connects the crease with the part below. The next operation is to tie the package, which is done by laying it on the flat or labelled side, and passing the string first across it and then lengthwise, securing it by a bow-knot at the edge where it was first creased. When the package is large or quite oblong, the string is made to pass twice across it and once lengthwise. The string used should be thin and free from fuzz; linen is the best material. The ball of tying string may be put into a small apartment of the drawer and gradually unwound as required, or it may be used from a reel.

Fig. 254.

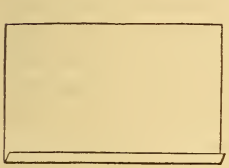


Paper package.

Small powders for containing but a single dose of medicines should be put up in glazed writing paper. The kind called *flat-cap* is economical and adapted to the purpose. A sheet of flat-cap will furnish sixteen of the most common size, or nine of the larger or Seidlitz powder size. Fig. 255 represents the shape of these. A little crease is made along the long side into which the opposite edge is laid, and the paper being folded over is laid down in the crease just beyond the middle, or *at* the middle, according to the width desired. The ends are now folded over a spatula so as to make flaps of equal length, and the package or powder, as it is called, is complete. In dispensing simple powders, I use small

envelopes, Fig. 257; there are several sizes, which leave nothing to desire. Those opening at the end, Fig. 258, are in greater request, as the papers contained are less liable to drop out.

Fig. 255.



Paper for power.

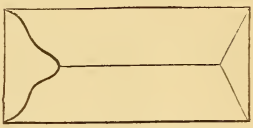
Fig. 256.

"Powder."

Fig. 257.

Envelope for powder.

Fig. 258.



Powders are often directed in considerable numbers, frequently, as in Prescription No. 73, twelve at once; in this case, it is important to have the powders all of one length, so as to fit in a little box, called a powder-box or lozenge-box.

The boxes used for pills (when pasteboard ones are employed), lozenges, and powders should have their appropriate labels pasted on them beforehand, so that there will be no unnecessary detention, and no liability of causing the ink to "run" and thus disfigure and render the directions indistinct. Directions for Seidlitz powders in single pairs, which are dispensed most neatly in envelopes, should be thus affixed and dried before the powders are placed in them.

Gauges for folding powders are sold by dealers in druggists' sundries; their use is twofold—to regulate the length of the powder, and to facilitate the folding; the two end creases are made by simply pressing the paper over the blades between the thumb and finger.

The expense of these is saved by cutting a piece of tin of the required width, and tacking it on to one corner of the slide appropriated to powders. With a penknife, the board may be cut out to the thickness of the tin, so that the paper will slip readily on to the tin, and be turned over by the thumb and finger; this is substituted on the counter shown in Figs. 34 and 35 by a small wooden powder gauge screwed on to the face of the slide appropriated to dispensing powders; a great many powders can be folded in a few minutes by the use of this simple contrivance which takes up no room and is never out of the way when wanted.

Powders are often dispensed in bulk to be divided by the patient according to some standard of proximate measurement, for instance, as much as will lay on a sixpence, or may be taken up by the point of a penknife, or will fill a salt spoon; this has the advantage of economy in cases where the treatment is likely to be continued for a long time; but, as a general rule, it is better that the doses should be divided by the pharmacist, whose eye becomes accustomed to the least deviation from accuracy in dividing. The pharmaceutical

tyro should practise weighing successively definite quantities of the more commonly prescribed medicines, and laying them out on appropriate papers so as to become proficient in dividing them by the eye.

When dispensed in bulk with a view to being taken at intervals in approximate doses, powders should be put into vials with tolerably wide mouths, or into turned wooden boxes, such as are used for tooth powders, not into ordinary paper packages. Volatile or deliquescent powders, whether in bulk or divided in separate papers, should be dispensed in wide-mouth vials well corked—the same is true of charcoal and magnesia, which are otherwise apt to be scattered over surrounding objects and wasted.

The Dispensing of Liquids.—By attention to the liability of liquids to ferment, or to part with volatile active principles, or to deteriorate by exposure to atmospheric influence, the pharmacist will learn that advantages almost invariably result from the selection of well-stoppered pint and quart tincture bottles for the dispensing shelves in preference to half gallons and gallons. These bottles are necessarily frequently opened, admitting air and allowing of evaporation, and they are exposed to bright light which is one of the most potent causes of chemical change; bottles of these sizes are also much more convenient to handle than larger ones, and by having suitable funnels at hand, may be replenished as often as required from stock bottles kept in the cellar or other appropriate depository.

Under the head of solution, in the third part of this work, and of the liquid forms of medicines in the fifth part, and, indeed, throughout all the practical parts, I have endeavored to impress such facts connected with the preparation and use of this class of medicines as would be most useful to the student, and I may conclude the subject here by reference to the selection of vials, corking, labelling, etc.

Of the several varieties of vials shown in Part I., the kind best adapted to the purposes of the country physician and to the great majority of pharmacists is the German flint, Fig. 259; it has the advantage over the flint vial of being cheaper, and stronger; while it is far better than the common quality of green glass. The manufacturers of green glass make many of their vials without lips, from the fact that dealers in handling and repacking the lipped vials suffer loss from these being much broken about the lip. A vial is, however, of little use for many of the purposes of the physician without a good, rather broad, and thin lip, which will allow of the pouring of the liquid from it without its running back and down the outside. This is especially true of small vials from which drops are to be administered.

Fig. 259.

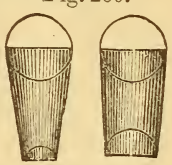
German flint vial.

Many of the large dispensing establishments have adopted their own distinctive and uniform styles of vials, which are made in moulds of all the sizes required for ordinary dispensing, and are

certainly more *recherché* and characteristic than any that could be found in commerce. Other leading stores, not seeking any peculiarity in their style of vials, are content to purchase the best productions of the New England Glass Company, who produce glassware probably unsurpassed in elegance by any in the world. Numerous manufactories in other parts of the United States, especially in Pittsburg, Pa., are largely concerned in supplying flint glass prescription and dispensing vials fit for the best class of customers in our country.

With a view to economy of time, the sink for washing vials, the vials themselves, the labels and corks, will be conveniently located near the front of the shop, and it is very desirable that an assortment of these necessary articles for dispensing liquids shall be always within reach of the counter clerks, in a condition for immediate use. The mode of disposing the assortment of washed vials differs in different establishments; some hang them while yet moist on nails or pegs with the mouth inclined downward that they may drain and be free from liability to collect dust, until wanted for use. This method takes more space than is generally at command, and seems to be less desirable than keeping them in a partitioned drawer. The sink should have shelves or racks arranged over it for draining recently washed articles, and the vials should not be put into the drawer for use till dry. In the Preliminary Chapter, the variable quality of corks is referred to, and it is only necessary again to call attention to the great advantage in this as in most other purchases of selecting the best, and especially those of the kind called homœopathic, which are fitted with much greater facility to the vials.

Fig. 260.



Tapering and straight corks.

There is no economy in procuring cheap corks, as prices are pretty exactly according to quality, and of the inferior qualities a large number are quite unfit for use.

The cork drawer should not be too near the fire, as they are deteriorated by long-continued drying. The cork should always be adjusted to the bottle before putting the liquid into it, so that if it should not fit, it may not be injured by contact with the liquid, and may be thrown in with the corks again.

The neat appearance depends chiefly on its being clean and having a clear fresh surface at top; this may generally be attained by the use of a sharp knife, care being taken not to cut it off so short as to be inconvenient to extract again. The practice of capping over the cork with a piece of fancy paper or damp kid gives a handsome finish to the preparation, and secures it from being opened by children or others who may be sent for the medicine; but in small sales it scarcely repays for the time consumed.

The most finished method for dispensing prescriptions is without doubt the metallic foil cap made of a size appropriate to the vials to be capped; these are generally stamped with the name of the dispenser.

Heavy and good quality tinfoil is a beautiful capping for corks, and may be applied without a string to secure it; it will take the impression of a stamp with considerable distinctness. With a view of capping operations, a small pair of scissors, different from those adapted to the general purposes of the counter, will be almost indispensable.

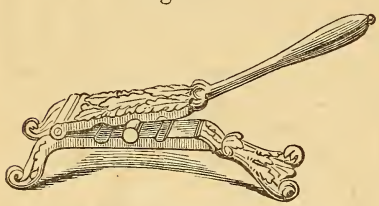
Fig. 261.

Spirit lamp.

The fashion of stamping the cork at the top with a die upon sealing wax has lately become quite general; to accomplish it with facility and neatness a small spirit lamp, Fig. 261, or a similar lamp made with a vial and glass tube should be provided; the flame of alcohol is best for the purpose, because not liable to smoke the wax. A stamp should be provided with the name or initials, or some appropriate device or trade mark, which will give character to the preparation dispensed and indicate its origin.

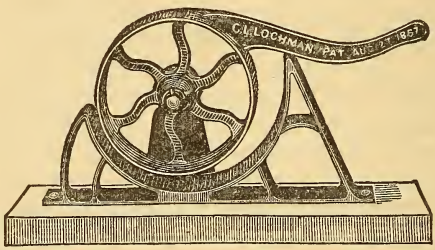
The cork presser, Fig. 262, is now so common and well known as scarcely to require mention; in using it, care should be taken to press the whole length of the cork, otherwise, if it is rather dry, it may be cracked at the point where the pressure of the machine ceases, and hence will break off in attempting to remove it from the bottle. It is best adapted to the larger sized corks, and is quite unsuitable to be applied to "homœopathic corks." An improved cork press patented by C. Lochman is also figured. It consists of a segment of cast-iron spiral fastened to a suitable block, and a wheel which is partially rotated, thus

Fig. 262.



Cork presser.

Fig 263.



Lochman's rotary cork press.

running the cork between the interior of the spiral and the surface of the circle. As the wheel rotates it carries the cork further into the space, which gradually diminishes; the cork is thus pressed uniformly, and is not so likely to be crushed.

*For*_____

Take a teaspoonful every hours, as directed.

*Dr.*_____

*For*_____

Take a teaspoonful times a day, as directed.

*Dr.*_____

*For*_____

Take a tablespoonful times a day, as directed.

*Dr.*_____

Powders.

Take one every hours, as directed.

*Dr.*_____

Powders.

Take one times a day, as directed.

*Dr.*_____

AS DIRECTED.

*Dr.*_____

Take drops times a day, as directed.

*Dr.*_____

Take drops every hours, as directed.

*Dr.*_____

PILLS.

Take one every hour as directed.

Dr.

FOR EXTERNAL USE.

PILLS.

Take one three times a day, as directed.

Dr.

SHAKE THE VIAL.

PILLS.

Take one three times a day, as directed.

Dr.

PILLS.

Take for a dose, as directed by

Dr.

PILLS.

Take one every hour as directed.

Dr.

Labelling medicinal preparations is very much neglected by country practitioners, frequently for want of facilities; it is, however, too important a matter to be overlooked in any well-ordered dispensary. A small sheet of blank labels may be procured for a trifling sum, adapted exactly to the wants of the particular individual, or the druggist should have them printed for his customers. I have for several years sold sets somewhat like that on the preceding page, which by filling up the blanks serve most the purpose of the physician.

The apothecary will of course have, besides his ordinary printed slip labels, suitable prescription labels, with his business card and an appropriate space for filling up with the names of drugs, or with directions and the number and date of the prescription, for future reference. Few things add more to the reputation of the apothecary than the neatness and elegance of his labels, both in printing and chirography.

Fig. 264.

Paste bottle and brush.

Some pharmacists prefer to gum all their labels so that they will adhere by moistening alone; this is done by a solution of dextrine in water painted over the surface and allowed to harden, or by a mixture of one part of sugar to two of white glue, dissolved in five parts of water by heat, and applied while yet warm.

Fig. 264 shows a convenient wide-mouth bottle, which may be of f℥ij or f℥iv capacity, with a perforated cork into which a plug is inserted, extending half an inch below the cork, on to which is glued a camel-hair brush, always dipping into the paste; this little vial may be supplied with paste from another and larger bottle. The paste may be made by either of the following processes:—

Paste containing Glycerin.

Take of	Gum Arabic	One ounce.
	Boiling water	Two fluidounces.
	Glycerin	Two fluidrachms.

Make a solution.

Paste preserved with Acetic Acid.

Take of	Powdered gum Arabic, Powdered tragacanth, of each	℥ss.
	Water	℥iss or sufficient.
	Acetic acid	♏xx.

Mix them.

If tragacanth paste is made stiff enough, it will keep without the addition of an antiseptic.

When not previously prepared, the labels require to be pasted at the time they are applied; this may be accomplished by laying them successively upon a piece of soft paper, which must be renewed as soon as it becomes somewhat daubed, or by laying them on a

piece of smooth and hard wood, which should be cleaned and dried once every day. When the label is applied to glass, it should be covered by a piece of paper somewhat larger than itself, and tightly and uniformly pressed till quite smooth; it is a mistake to put a thick coating of paste on the paper, as it then spreads on to the surrounding parts of the vial, soiling them, and in drying shrinks and wrinkles the label. When filled and properly corked, the vial should be carefully wiped off and wrapped in a piece of white paper. The ¼lb. size, 9½ x 8 inches, is suitable for a f℥iv vial.

A good pen, with a fine point, suitable for filling up the blanks on the labels, and a desk, should be within convenient reach; also a blank book or file on which to preserve the prescription for future reference, the day book or blotter, the book of "wants," in which each article is to be entered for purchase or preparation, before it is entirely out, and a note-book of facts and experiences, which, if diligently kept, will, by lapse of time, become a valuable heirloom of the office or shop.

Reading the Prescription.

The first process, on receiving a prescription to be compounded, is to read and thoroughly to understand it; this can be done, in many cases, only after some study and consequent delay, which, if perceived by the applicant, may occasion distrust and a suspicion that something wrong is contained in it; to obviate the appearance of a misunderstanding, it is a good plan to commence by preparing a label; this is done with the prescription before the eye of the writer, and allows time for thoroughly studying it and deciphering, as far as practicable, the obscure parts, before attempting to compound it. After the preparation has been completed and labelled, the prescription should be carefully reviewed and the several articles, as added, recalled so as to insure its correctness before sending it out freighted, as it may be, with the issues of life or death to the sufferer for whom it has been prescribed; there are few errors occurring from carelessness which would not be obviated by this precaution. If there should be an obvious error in a prescription which might lead to serious consequences, it would become the duty of the pharmacist either to supply the medicine, so modified as to be safe, and to fulfil the intention as nearly as he can arrive at it, or, on a plea of necessary delay, to obtain an opportunity to have the error corrected by the physician himself.

The maintenance of a spirit of professional comity between the physician and pharmacist, by which each is bound to screen the other from unjust censure, while they mutually endeavor to protect the community from the dangers unavoidably attendant upon the administration of remedies, is the only true basis of their successful co-operation.

Preparation and Dispensing of Pills.

The advantages of this form of preparation having been fully detailed in Chapter III., the substances best adapted to it having

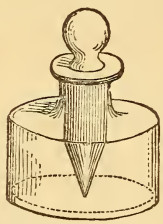
been enumerated, and the general principles on which they should be compounded having been treated of, it remains now to convey such information upon the mode of mixing and forming pill masses as can be put into a brief description, premising that of the manual processes of pharmacy, none more distinctly require to be learned by experience.

To form a pill mass, the ingredients in the form of powder, being weighed, are placed in a mortar, or on a tile, and thoroughly mixed; two spatulas being at hand, a small addition of some excipient, as already pointed out, is to be made, care being taken not to add an excess, which the inexperienced are apt to do. The little bottle, Fig. 266, is made for the use of the analytical chemist in moistening substances with a single drop of a reagent; it will be useful to contain water for the purpose named. The drop guide, Fig. 265, or a similar extemporaneous contrivance, will answer the same purpose. Many pill masses are spoiled by getting a few drops too much water accidentally into them; they should always be very thoroughly triturated before the addition of fresh portions of liquid.

Fig. 265.

Bottle with drop machine.

Fig. 266.



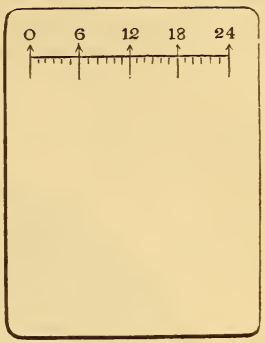
Bottle for moistening pill mass.

The use of extracts in making pills has already been adverted to as aiding in their pharmaceutical eligibility; but the toughness of certain resinous extracts, as extract of jalap, is one of the greatest causes of difficulty in the manipulation. The extract seems sometimes to have dried to just that condition which forbids the idea of reducing it to powder, or softening it to the proper consistence of an excipient, and therefore it cannot be successfully incorporated with other extracts, or with dry powders. Under these circumstances the aid of heat should be called in; a mortar being warmed upon the stove, the extract may be introduced into it and thoroughly softened by trituration, or if still too tough, being broken up, the mass may be subjected to drying, until, on cooling, it is so brittle as to be readily reduced to powder, and then incorporated with the other ingredients and rendered plastic by suitable excipients.

Another difficulty in manipulating with extracts is owing to their sometimes being too soft to form a mass of sufficient firmness with the other ingredients prescribed; in this case it is, perhaps, generally best to spread the extract in a thin layer upon the tile and warm this till, a portion of the moisture being evaporated, it assumes the proper consistence. Care is, of course, necessary not to deteriorate the extract by burning, or the evaporation of any volatile principles. The warmth, moisture, and flexibility of the hand may frequently be brought into requisition with materials that refuse to soften and adhere, though generally it is desirable to avoid working

the mass in the hands in presence of the customer; when the materials are readily miscible, the whole process may be conveniently performed in the mortar, and the removal of the mass completely effected by the use of the pestle and spatulas.

Fig. 267.



Graduated pill tile.

Some pharmacists prefer the use of the pill tile and spatula for the whole manipulation, and I have observed that some of the most successful pill makers avoid the use of the mortar almost entirely; on the other hand the greater force imparted to trituration by the convex surface of the pestle upon the concave mortar, and the facility it affords in thoroughly powdering and mixing the ingredients, seem to me to indicate the superiority of this old-fashioned method; the force of early training and of habit in this as in most other cases has a controlling influence.

In using the pill tile, Fig. 267, for mixing the mass, an implement is required which will facilitate the powdering of crystals, dry extractive, and resinous materials, and powders, which have agglutinated. Fig. 268 shows a muller, made of glass for this purpose; the flat bottom surface is ground to adapt it to trituration; it is not used in forming the mass, but is well suited to the preparation of the dry materials.

Fig. 268.

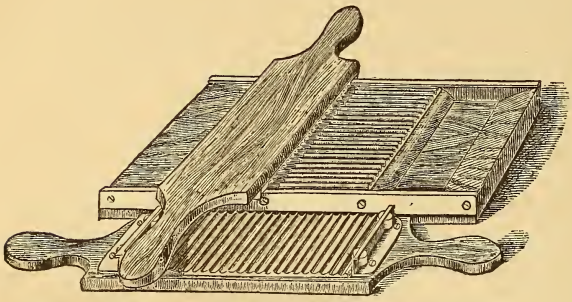
With a view to securing both tenacity and firmness in a pill mass, it seems essential that the several ingredients should combine the property of fluidity with that of hardness or insolubility. A solid substance, like aloes or almost any of the resins or gum resins, can readily be formed into pills with a little alcohol or some appropriate tincture, but for want of a substance insoluble in this excipient the pills will be apt to fail of that firmness of consistence which results from the combination of solid with liquid particles; soap is in this case a better excipient, being less of a solvent for the resinous particles, and possessing a body which prevents the softening and flattening out of the pills.

Whenever practicable, it is best for the pharmacist to use the excipient prescribed by the physician, but there is nothing to prevent his adding inert excipients, when necessary, according to his own judgment, and the frequent absence of any specific directions on the subject makes it necessary for him to choose the best excipient to insure smallness of bulk, adhesiveness and firmness in the mass; experience and a careful study of the subject, as presented in Chapter III., will aid in this selection.

Pills may be divided with a spatula, by the eye, or by the aid of a graduated tile; a great many pharmacists use this altogether, but it has always appeared to me it must be from want of familiarity with the use of the pill machine, Fig. 269. If the mass is

plastic, it may be rolled between the smooth surfaces, or by use of the pill roller, Fig. 270, into a perfect cylinder equally thick at both ends, and by then adjusting the cutting surfaces, the whole mass will be immediately turned into the appropriate number of

Fig. 269.



Brass pill machine.

Fig. 270.

Pill roller.

pills, which, if about the size appropriate to the machine, will be so round as to require no further rolling. In large dispensing establishments, several machines are sometimes kept adapted to different sizes, one for pills of opium or Quevenne's iron, another for compound cathartic or aloetic pill, and another for compound rhubarb and other large pills. In the U. S. Army laboratories immense numbers of pills were made with these machines by female operatives. There is a practical hint in relation to the use of the pill machine which should be mentioned in this connection; it is, that the cutting surfaces will sometimes only work on each other perfectly in one way; every roller is, therefore, marked with a star, a little brass tack, a number, or some other designation, and a corresponding one is made on the machine, indicating in which direction the roller is to be worked on the machine in cutting. From not being aware of this precaution, many abandon the use of a machine, which is one of the greatest of conveniences in pharmacy. In the machines made by Wurtz the rollers work equally well in both directions.

Pills should not be put away for dispensing purposes until well dried on a tray, an open box lid, or paper folded at the edges for the purpose. There are several kinds of pill boxes described on page 56, of which the best is that made of paper with projecting top and bottom piece, Fig. 82. Pills containing volatile ingredients should be dispensed in a small wide-mouth vial. Such are made for this purpose.

Fig. 271.

Dusting bottle.

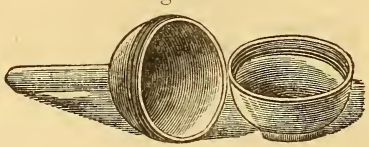
Fig. 271 shows a bottle arranged to contain lycopodium, powdered liquorice root, or sifted arrowroot, one or more of which may be kept at hand in dispensing pills, both for the dusting of the pill machine, and for filling boxes in which they are dispensed. One of these bottles may have powdered gum Arabic also, so

as to add that ingredient conveniently to pill masses in process of their manufacture. The mode of construction will scarcely need a remark; a perforated cork, short piece of tube, and ℥j or ℥ij vial constitute the apparatus.

Coating of Pills.—Though the least repulsive form of medicine, yet pills, especially when they contain bitter and nauseous ingredients, are disagreeable to some, and many ways have been devised to render them more attractive and pleasing to the eye and to hide the odor and taste of drugs given in this form.

Since the issue of the earlier editions of this work the ancient practice of coating pills with silver and gold leaf has been revived. The apparatus I have had constructed for this purpose is shown in Fig. 272. It consists of two hemispheres of hard wood fitting by a screw and highly polished on their inner surface. In rolling the pills care is taken to use no dusting powder of any kind, and to have them moderately damp, otherwise to moisten them with a little syrup. They are then introduced into the hollow sphere along with the requisite quantity of silver or gold leaf, it is tightly closed by screwing the separate parts together and a rapid motion is communicated to it; in a few seconds the pills are removed with a clean and bright coating. One dozen pills of average size require one sheet of foil and larger numbers in proportion. Some difficulty is experienced in giving a handsome coating to pills of Quevenne's iron, on account of their black color; this can be obviated by the use of a large proportion of foil, which may be objectionable as interfering with their solubility, notwithstanding the extreme tenuity of the foil. The taste of the pills is of course disguised in proportion to the completeness of the coating; in dispensing no powder is necessary, the tendency of the fresh pills to adhere to each other being obviated.

Fig. 272.



Apparatus for silvering pills.

This apparatus may be substituted by using a gallipot laid against the palm of the hand, or by two porcelain capsules fitted to each other, the opening at the lips being covered by the thumb, but there is a saving in the use of an apparatus as above figured; any portion of the foil not adhering to one charge of pills will be ready for the next, besides an advantage which is gained by the leverage of the handle.

The former belief that a coating with metallic leaf, if sufficient to hide the taste and smell of the pills, would interfere with their solubility, has been very much modified by recent experience. The pharmacist should assure himself of the genuineness of his gold-leaf, as Dutch metal, which is so often substituted for it, contains both copper and zinc.

A coating with gelatin is one of the most elegant and efficient expedients for disguising the odor and taste of pills; this is accomplished by preparing a solution of one part of gelatin in two of

water, by a water-bath heat; and having prepared the pills, pretty firm and dry and free from any powder on their surface, they are dipped into the gelatin by means of long pins, which are then placed in a position to allow the pills to dry without contact with each other. On being removed from the pins any superfluous gelatin is clipped off with scissors and the holes touched with gelatin from the point of a camel's hair brush if deemed necessary. This coating is smooth and glossy, and when the pills are kept dry leaves nothing to desire; it effectually excludes all deteriorating influences, and pills thus covered may be kept for an indefinite time without losing their medicinal properties; they, moreover, have an elegant appearance from the transparent nature of their surface, which may be colored to suit the fancy, by introducing into the solution of gelatin a sufficient quantity of coloring matter, which is soluble in water.

Sugar-coated pills are now very popular and widely diffused. Their method of manufacture is much better understood by confectioners than by pharmacists; the coating of objects with a glossy saccharine covering is, in fact, a prominent part of their business. On a large scale the sugar coating is managed by constantly rotating the moistened pills in a mixture of starch and sugar contained in a copper pan suspended at a considerable distance above a small charcoal fire; they thus acquire a smooth and glossy surface, familiar to us in pills from most of the leading pharmaceutical manufacturers. There are several ways in which a similar coating may be effected at the prescription counter; in all cases very finely-powdered "dusted" sugar is requiste; some use a mixture of sugar and gum Arabic, which must be intimate and rubbed to the very finest powder. Upon a pill tile, six or eight pills receive a thin covering of mucilage of gum Arabic or tragacanth, by being rolled in it quickly by means of the fingers; they are then immediately transfered to another tile, upon which a thin layer of the saccharine powder has been dusted, and the sugar is made to adhere by giving the pills a rotary motion with the ends of the fingers, slightly pressing on them.

The covering of sugar may also be satisfactorily made by using the silvering globe, the inside of which has been highly polished. Some of the powder is sprinkled into the hemisphere, and, after the introduction of the pills previously moistened with mucilage as before, an even coating is effected by giving the box a quick circular movement. The pills are afterwards allowed to dry in a box, and may be made somewhat smoother by rolling them in finely-powdered starch.

If thus treated, a good white coating is obtained, which, however, lacks smoothness and elegance if compared with the confectioners' manufacture, but answers all the required purposes.

If it appears desirable, the sugar may be previously colored by incorporating a few grains of carmine with it, or rubbing with it some good saffron to a very fine powder, if a yellow color is desired; the latter fades if exposed to the light.

Pills may be extemporaneously coated with sugar by first moistening them with a strong solution of balsam of Tolu in ether, throwing them immediately into a box containing sugar in very fine powder, and shaking the box for a few minutes; the application may be repeated if the first coating is not sufficiently thick. The ethereal solution has the advantage of extreme volatility and of not dissolving the ordinary constituents of pill, but should it prove objectionable on account of a solvent action on the pills it may be replaced by mucilage as before indicated.

Furley's process, patented in England, is directed to be performed with two saucers, the inner surface of one is coated with albumen, prepared by well agitating the white of an egg, the other contains a fine powder, composed of equal parts of sugar and tragacanth. The pills are placed in the first saucer and are made to revolve in it by a series of horizontal circular motions; this speedily coats them with a thin film of albumen; then they are quickly transferred to the other saucer in which they are again caused to revolve and become coated with the mixed powder of sugar and tragacanth. The peculiar tenacious consistence of the albumen tends to prevent the pills from getting a very thick coating, but it is sufficient if continuous to fix a thin surface of the powder sufficient to form a thin but firm and tough coating when dry. The quantity of albumen to place in the saucer must be learned by experiment; it should not be in excess, lest the pills get too heavy a coating and dry too slowly. Albumen has the merit of ready solubility in the stomach, and seems to be well adapted to the object in view.

In an elaborate article on coating pills, Bernard S. Proctor, of Newcastle-on-Tyne, England, has given the results of no less than forty-five experiments, which go to show that the process is in the main advantageous. He prefers those processes in which the pills are first rolled in a mixture of alcohol and water, or in lac varnish, and then in an appropriate powder. Rolling first in tincture of lac, and then in a mixture of three parts of French chalk and one of resin, gave a coating not liable to absorb moisture, and possessing most of the requisites sought. He recommends that the quantity of tincture should not exceed 4 or 5 minims to a dozen pills, and it is evidently an important precaution in any of the processes to moisten the pills as little as practicable to secure a continuous coating.

The covering with sugar is preferred generally in the United States; it prevents the smell and taste from manifesting themselves for a number of days; but, if freshly-made pills have been thus coated, the evaporating moisture, in penetrating through the sugar, may carry some soluble matter with it and gradually discolor the covering; in a similar way, odorous principles will penetrate to the surface, and finally impart their smell; sugar-coated assafœtida pills, though at first nearly free from odor, develop it on keeping.

The observation of those whose opportunities have given them abundant means of forming a correct judgment has resulted in a

preference for well-made sugar-coated pills over those not so protected, as the coating prevents the desiccating action of the atmosphere and its other accompanying injurious effects. The *Pharmacopœia* sanctions the custom of sugar-coating so far as concerns those pills which are designed to be slow in their action but not in regard to others.

Sugar pellets or *granules*, variously medicated, have been very much prescribed within a few years. They have gained favor with physicians from their portability, and with many patients on account of their very small size, which adapts them to be taken more readily and easily than ordinary pills. Sugar granules are made by the confectioner, of white sugar, sometimes artificially colored. They are medicated in the following way: The dose to be contained in each granule is first determined; the medicinal substance is then weighed out in such a quantity as may be evenly divided into the proper doses; it is now dissolved in strong alcohol or ether, sufficient to moisten the requisite quantity of pellets, which are to be constantly agitated in a shallow dish so that the solution may become evenly divided among them, until the solvent has evaporated.

It is evident that, prepared in this way, the globules may vary somewhat in the quantity of the absorbed solution, and it is therefore important that the agitation be continued without intermission until no trace of moisture can be detected; the employment of the strongest alcohol or ether is necessary, so that the larger amount of the solvent may be employed without liquefying the sugar. Only such medicines are adapted to this mode of preparation as are given in very small doses, and the vegetable alkaloids and some neutral principles are particularly adapted to it. Generally, more than one of the granules contain the full dose of the medicine. It has become customary to have them contain the one-hundredth, one-fiftieth, one-twentieth, or the one-sixteenth part of a grain of the medicinal compound. As before noticed, this process is that introduced by the homœopathic practitioners, and has such defects inherent in the practice as are pointed out above. The only true plan is to divide exactly the medicinal agent into the fractional portions intended, and then coat these skilfully with sugar.

Preparation of Mixtures.—In the chapter on Liquid Preparations, pages 829 to 834, a list is given of medicines best adapted to this form, and a pretty full account of the principles which should govern the prescriber in the exercise of this part of his duties. The study of such a treatise by physicians would save many blunders which fall under the observation of pharmacists; it would also add to the facilities of the physician for combating disease, and to the comfort of those compelled to undergo medical treatment.

The preparation of mixtures and other liquid extemporaneous preparations involves the exercise of greater judgment and skill, because of the frequent unskilfulness of prescribers. The experienced pharmacist will frequently have opportunities to correct apparent incompatibilities without materially varying from the prescription, and in this as in other forms of prescription it will

sometimes be his privilege to detect and obviate errors which might be of serious import. Let him never allow a preparation to pass from his hands without a careful consideration as to whether a mistake of his own or of the prescriber has escaped his notice.

The ingredients contained in mixtures are generally both solid and liquid, and of the solids some are soluble and others diffused in the liquid only by admixture; the object of the pharmacist should be the intimate blending of all the ingredients, so that every dose when taken shall be of the same composition. In most of the formulæ involving any difficulties as given in the previous chapter, the mode of admixture has been indicated, but a large number will fall into the hands of the pharmacist in which the mode of incorporating the ingredients together will be left entirely to his judgment.

If all the ingredients prescribed are liquids, or if the only solid is freely soluble, they may all be introduced directly into the bottle, previously prepared, and the whole may be mixed by agitation. The most ready mode of dissolving crystals is explained in the fifth part of this work, in the chapter on Solutions, page 553, and the distinction to be observed between those substances readily soluble by agitation and those requiring the triturating action of the pestle and mortar.

With a view to obviating the liability to precipitation from mixing either chemical or pharmaceutical incompatibles, it is desirable, *first*, to make as dilute solutions as the prescription will allow, of any chemical substances ordered; *second*, to incorporate with these the syrups or viscid excipients, if any such are prescribed, before mixing them. In this way the play of incompatibilities is diminished by the twofold influence of dilution and viscidity, and the liability to unsuspected chemical changes, the fear of which occasions such trepidation to the inexperienced prescriber, will be greatly lessened.

As a general rule the mortar and pestle should be used in case of incorporating an insoluble substance in powder with a liquid; the plan of mixing by agitating in a vial is seldom perfectly successful, and where these are suspended by the aid of gum and sugar it is best to have them thoroughly triturated together as powders before adding the liquid ingredients.

Emulsions are mixtures of oils, fats, or resins with water, generally promoted by alkalies, gum, or gum and sugar, and white or yelk of egg. Numerous examples of this kind of preparation are given among the foregoing prescriptions. Mistura Assafœtida and Mistura Ammoniaci are instances of what might be called natural emulsions, the conditions of an insoluble resinous ingredient and a soluble gum being present in the gum-resin prescribed. In Copaiva Mixture, No. 122, Castor Oil Mixture, No. 105, Chloroform and Oil of Almond Mixture, No. 96, Emulsion of Cannabis Indica, No. 99, and others, we have instances of artificial emulsions in which an oily ingredient is properly suspended. The instructions for making each of these are so specific that they can scarcely fail to realize a

successful combination and furnish a clue to similar preparations. It may happen that an emulsion constructed on this plan will partially separate into layers and need shaking before being taken; but if properly made it will never have the oil floating in globules upon the surface. There can be no doubt of the increased action of emulsionized oils over those in which the oil globules have not been broken up, though on the other hand it is less easy to take a dose of oil emulsionized than floating on the surface of water or enveloped in the froth of porter or sarsaparilla mead. It is generally customary to weigh the fixed oils or copaiva in dispensing them, but if this is done when they are to be made into emulsions it should not be done in the bottle in which they are to be dispensed. The adhesion of the oil to the glass will interfere with its complete separation into an emulsion, and a portion of this adhering oil will contaminate the emulsion when made and be apparent in each dose drawn from the vial. In the elegant emulsions of almonds, No. 120, and of pumpkin seeds, No. 143, the fixed oils present in the seeds are naturally associated with mucilaginous ingredients which emulsionize them in water without the addition of any foreign ingredient.

Volatile oils, especially oil of turpentine and oil of copaiva, require the admixture of fixed oils in order properly to incorporate them with viscid materials, or they may be mixed with yelk of eggs, an admirable natural mixture of a fixed oil with albumen.

Fig. 273.

French porcelain mortar.

For making emulsions I prefer the French pattern porcelain mortar, Fig. 273; in this a thick mucilage is first made and the oil added, while by trituration the combination is effected completely and satisfactorily.

It is noticeable that emulsions are usually quite incompatible with neutral or acid salts, though rather improved by some alkaline salts, as borax, by carbonated alkali, and by caustic ammonia. They are also incompatible with any considerable proportion of alcohol, though moderate quantities of the tinctures, made with diluted alcohol, may be added after they are fully diluted.

Fig. 274.

Measure for fixed oils.

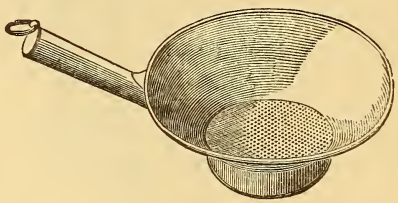
If spirit of nitric ether is prescribed, associated with gum Arabic, it is well to dilute the mucilage to the greatest extent allowable before adding the spirit, otherwise there is danger of the precipitation of the gum.

In making neutral mixture the use of fresh lemon-juice is prescribed, and when the juice of the lemon is separated by expression with a "lemon squeezer," or otherwise, a strainer, Fig. 275, is a useful appliance. It is sometimes quite impracticable to filter this prepara-

tion while the patient waits, and the *Pharmacopœia* directs that it should be strained through muslin, which should be of an open texture and previously moistened with water.

In the compounding of mixtures and of other forms of liquid preparations, as well as in the ordinary operations of dispensing, one or more graduated measures will be required; these should always be at hand in a designated place, cleaned ready for use; the duty of placing them there should devolve upon one person in the shop, or upon each one after using them, as may best suit the general regulations.

Fig. 275.



Strainer.

For convenience in measuring oils and copaiva it is well to keep a separate graduated glass, and the small round bottom graduate used for medicine chests, Fig. 274, will serve a good purpose, being easily cleaned and of sufficient capacity for the purpose.

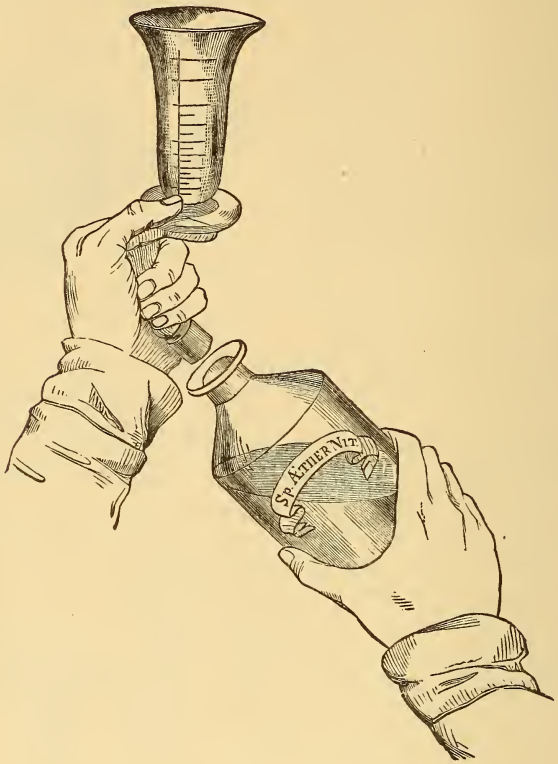
In measuring liquids the pharmacist draws from the tincture bottle both for dispensing directly and mixing in prescription, and the habit should be fixed, of holding the stopper by the little finger, while holding the measure with the thumb and forefinger. The measure must be held opposite the eye to measure the quantity with accuracy, and, after it has been done, the stopper is immediately to be replaced and the bottle set back on the shelf. The whole process is well shown in Fig. 276. The liability to mistakes in compounding is greatly increased by the accumulation of bottles on the counter; and it should be the habit to replace each bottle immediately, and to note the label as it is taken down and as it is put back; if a drop of liquid remains on the lip after decanting, it should be collected on the point of the stopper before putting it in again, and thus prevented from running down the side.

Much also depends on the method of restoring the stopper as to the facility with which it can be withdrawn again. Syrups, when allowed to remain in quantity between the ground stopper and neck of the bottle, dry and harden so as to be withdrawn with great difficulty; the same is true of alkaline solutions and resinous tinctures to a still worse degree. In handling the bottles it is important that the stopper and neck should be somewhat cleared of adhering liquid before restoring the stopper in its position. In the case of alkaline solutions it has been recommended to coat the stopper with paraffine, which is not acted on by alkali and prevents the adhesion complained of.

The modes of removing adhering stoppers—by the well-directed force of the thumb and fingers, by sudden strokes of a spatula-handle or mallet, by soaking the stopper in any appropriate solvent collected on the lip, and by the various modes of heating the neck

of the bottle—will suggest themselves to the ingenious manipulator, and will doubtless meet with varying success.

Fig. 276.



Ointments and Cerates.—No part of the duties of the pharmacist is considered so disagreeable as that which involves those manipulations with fatty matters necessary to bring them to the condition of ointments and cerates. The only practical details which I deem it necessary to insist upon, are: 1st. The importance of fineness of all medicinal substances incorporated in ointments and cerates. 2d. The necessity of proper precautions to avoid rancidity in ointments; and 3d, cleanliness as absolutely essential to success in this department of the business.

Upon the first point no remarks are necessary other than to call attention to it in connection with the special directions contained in each formula. The solid ingredients of ointments should never appear through them as distinct specks; their consistence should be uniformly smooth. Whenever an ointment is rancid it should be thrown away—this is an invariable rule—and in order to prevent rancidity occurring they should be kept in well-glazed and well-covered jars, a piece of tinfoil being interposed between the

top of the ointment and the jar. The ointment closet should be in a cool place; large quantities, if kept on hand, should be in the cellar.

The youngest apprentice, who has generally the duty of "cleaning up," should be early instructed to keep the ointment slab or tile free from grease; this he may do by having a bottle of solution of caustic potassa near at hand and dropping a little on to the slab after it has been thoroughly rubbed with porous paper, and then washing it off with water; a little tincture of soap or of the officinal soap liniment will also aid much in cleaning the slab. Greasy spatulas should never be thrown with others into water to be cleaned; soft paper is the best material for cleaning them, and in all the cleaning processes it should be remembered that water rather interferes with than facilitates the removal of grease.

Suppositories.—Few pharmaceutical preparations have been considered so difficult as these, but this has chiefly arisen from the absence of specific and accurate directions for their preparation, and of suitable moulds in which to form them. The attempt to form pure cocoa-butter into suppositories is hardly ever completely successful, and combination with wax as directed by Dorvault (see page 826) is now found to be inferior to the admixture of a small proportion of spermaceti, which has the merit of congealing much more rapidly than wax, and hence favors the rapid and complete solidifying of the cones. The proportion of spermaceti may be varied according to the haste with which they are to be completed, and the exposure to heat to which they are liable afterward. In summer one-fifth of the whole may be spermaceti, in winter one-sixth.

There are two ways suggested for medicating suppositories; the most ready method is to introduce the medical ingredients, in powder or mass, into a conical opening in the base of the finished and hardened cone, which is then closed up by replacing into the orifice sufficient of the hardened cocoa-butter; the other and preferable process is to mix the dried and powdered ingredients with a portion of the melted fat by thorough trituration, and then to add the remainder, taking care to stir the mixture until it has sufficiently cooled and thickened to prevent the subsidence of the powder, and then to form it into moulds.

Some extracts may be incorporated very satisfactorily by rubbing them with a spatula on a tile, first with a drop of water, then with a little of the melted cocoa-butter. The aqueous extract of opium, which is much prescribed in this form of preparation, is best dried on a clear dry day upon a pill tile, reduced to a very fine powder, and triturated with sufficient melted cocoa-butter, so that five grains of the mass contain one of the extract; in this state it is not affected by the weather, and is readily distributed, either alone or with acetate of lead, tannin, Monsell's salt, or other astringents.

Substances soluble in cocoa-butter may be incorporated into the form of suppositories with great facility, by digesting them in the melted cocoa-butter previously to adding the spermaceti. Where there is liability to the presence of crystals of nitrate of potassium,

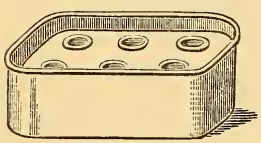
Fig. 277.

Suppository mould.

as in old extracts, or where any insoluble portion would interfere with the perfect smoothness of the suppository, the melted material should be strained before moulding it.

Fig. 277 shows a metallic mould of the proper size to make a suppository of twenty-five grains weight, the size preferred for adults, although sixty grains each has been sometimes prescribed. There does not seem to be any advantage in a large excess of the vehicle, and by having the cones of uniform size, their preparation is greatly facilitated. Fig. 278 is designed to show the arrangement of suppository moulds, with a view to their being readily chilled; this may be made of tin, the moulds fitting into a diaphragm which rests upon the surface of some iced water; when the suppository has quite hardened it will fall out by inverting the mould and striking it suddenly on a slab or tile. These moulds sometimes require cleaning, which is readily done by wrapping a piece of soft paper around the plug used for making paper cones, Fig. 279, and turning it several times in the mould. In the absence of these metallic moulds, paper cones will answer a good purpose; as their size is important, the following directions are given: a piece of glazed paper, not too thick, is cut into oblong pieces, $2\frac{1}{4}$ inches long by $1\frac{1}{2}$ wide, and rolled into a cone, which should be $1\frac{5}{8}$ inch long and $\frac{1}{2}$ an inch at the base; the free end of the paper is secured by a tip of sealing wax, which should be run around the base, and upon hardening retains the shape of the stick and keeps the cone from flattening; at the extreme point of the cone an eighth of an inch may be clipped off and the opening sealed up, though this is omitted by some of the best manipulators. A little wooden form we have had turned for folding the paper moulds upon is shown in Fig. 279; by having a shoulder on this to mark the base of the cone it may be trimmed with the point of a pair of fine scissors, following that line. After the requisite number of these cones has been made, the object is next to arrange them with the open end in a proper position to be filled; this is conveniently done in a box lid or other shallow vessel filled with flaxseed; sand is objectionable from its liability, if accidentally thrown into the cone, to produce irritation when the suppository is applied. My friend, Ferris Bringhurst, of Wilmington, Del., to whom I am indebted for some valuable hints upon this subject, uses a wooden stand with conical excavations, into which the paper moulds fit; this he sets in the ice chest in summer, or the open air in winter. The paper should not be removed from the suppository until it has become thoroughly hardened, and by this means it will

Fig. 278.



Suppository moulds in refrigerator.

Fig. 279.

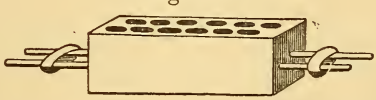
Form for paper moulds.

acquire a clean, polished surface. The time required to prepare and cool sufficiently a dozen or more suppositories is from half an hour to an hour. The physician prescribing them should bear this in mind, and not anticipate their being furnished by the apothecary immediately, unless of standard kinds known to be kept on hand.

The chief points to be observed to insure successful manufacture of this useful form of preparation are, *first*, the complete incorporation of the medicinal ingredient, in an impalpable powder, with the melted mixture of cocoa-butter and spermaceti; *second*, the chilling of the melted mass to such point that while it will flow from the cup or capsule it will not allow the rapid subsidence of the suspended powder; *third*, when using metallic moulds to have them so refrigerated in advance as to harden the suppositories almost immediately on contact.

The most convenient and useful mould has been found to be the brass mould, Fig. 280, opening like an ordinary bullet mould;

Fig. 280.



the cavities being included equally in either half of the mould renders their speedy removal from the instrument quite easy; as many as six or eight dozen suppositories can be made with a mould having a dozen cavities in an hour and a half.

Testings.

The following list of preparations of the *British Pharmacopœia* is here inserted under the head of extemporaneous pharmacy as a class, which the student should test by the different volumetric solutions, to familiarize himself with the process. The solutions have been described on pages 311–318, and the apparatus necessary to prepare and use these solutions comprises the following, using the weights and measures employed in the *British Pharmacopœia.*

1st. A flask capable of holding, when filled to a mark in the neck, exactly 10,000 grains of distilled water at 60°.

2d. A graduated cylindrical jar holding 10,000 grains of distilled water, and graduated into one hundred equal parts, the graduation beginning at 0 and being continued downward.

3d. A burette, which is a graduated tube capable of holding 1000 grains of distilled water, and graduated into 100 equal parts, commencing at the upper portion of the tube; each degree, of course, is equal to 10 grain measures.

The following lists are taken from Squire's *Companion to the British Pharmacopœia.*

The following are to be tested with the volumetric solution of bichromate of potash:—

	Grains weight of Substance.	=	Grain-measures of Vol. Sol.
Ferri Arsenias	20	=	170
" Carb. Sacchar.	20	=	330
" Oxid. Mag.	20	=	83
" Phosphas.	20	=	250

The following are to be tested with the volumetric solution of hyposulphite of soda:—

	Grains weight of Substance.	=	Grain-measures of Vol. Sol.
Calx Chlorinata	10.0	=	850
Iodum	12.7	=	1000
Liq. Calc. Chlorata	80 0	=	500
" Chlori	439.0	=	750
" Sodæ Chloratæ	70.0	=	500

The three following are to be tested with the volumetric solution of iodine:—

	Grains weight of Substance.	=	Grain-measures of Vol. Sol.		
Acid. Arseniosum	4.0	=	808		
Acid. Sulphurosum f℥j distilled water, a little mucilage of starch	34.7	=	1000	=	before a permanent blue color is obtained.
Liq. Arsenicalis	441.5	=	808		
" Arsenici Hydrochloricus	441.5	=	810		

The three following preparations of the *British Pharmacopœia* are to be tested by the volumetric solution of nitrate of silver:—

	Grains weight of Substance.	=	Grain-measures of Vol. Sol.		Per cent.
Acid. Hydrocyan.	270	=	1000	=	2 anhydrous acid.
Potass. Bromid.	10	=	840		
Sodæ Arsenias, dry	10	=	1613		

The following are to be tested with the volumetric solution of oxalic acid:—

	Grains weight of Substance.	=	Grain-measures of Vol. Sol.		Per cent.
Ammoniæ Carb.	59.0	=	1000		
Borax	191.	=	1000		
Liq. Ammoniæ	85.	=	500	=	10. by wt. of Ammonia.
" " Fort.	52.3	=	1000	=	32.5 " "
" Calcis	4380	=	1000		
" " Sacchar.	460.2	=	254		
" Plumbi Subacet.	413.3	=	810		
" Potassæ	462.9	=	482		
" " Efferves.	4380	=	150		
" Sodæ	458.	=	470		
" " Effervescens	4380	=	178		
Plumbi Acetas	38.	=	200		
Potassæ Caustica	56.	=	900		
" Bicarb.	50.	=	500		
" Carb.	83.	=	980		
" Citras	102.	=	1000		
" Tartras	113.	=	1000		
" " Acida	188.	=	1000		
Sodæ Caustica	40.0	=	900		
" Tartarata	141.	=	1000		
" Bicarb.	84.	=	1000		
" Carb.	143.	=	960		

The following preparations of the *British Pharmacopœia* are to be tested by the volumetric solution of soda:—

	Grains weight.	= Grain-measures of Vol. Sol. Soda.	Per cent.
Acetum	445.4	= 402	= 4.6 of anhydrous acid.
Acid. Acetic.	182.0	= 1000	= 28 " "
" " Dil.	440.	= 313	= 3.63 " "
" " Glacial	60.	= 990	= 84 " "
" Citricum	70.	= 1000	
" Hydrochloricum	114.8	= 1000	= 31.8 of gaseous hydrochl. acid.
" " Dil.	345.	= 1000	= 10.58 of real acid.
" Nitricum	90.	= 1000	= 60 of anhydrous acid.
" " Dil.	361.2	= 1000	= 14.95 " "
" Nitro-Hydrochloric.	352.4	= 920	
" Sulph.	50.6	= 1000	= 79 " "
" " Arom.	304.2	= 830	= 10.91 " "
" " Dil.	359.0	= 1000	= 10.14 " "
" Tartaricum	75.	= 1000	

Management and Discipline of the Shop.

The requirements of modern pharmacy call for greater discrimination than formerly, in the selection of youths as apprentices; these should possess a liberal education, a knowledge at least of the elements of the Latin language, and, what is more important, some preliminary knowledge of and taste for the natural and physical sciences, especially botany and chemistry. No lad should be allowed to undertake the duties and responsibilities of the drug business whose faculties of observation and reflection have not been awakened by previous training, and who does not bring to the pursuit a desire and a capacity to render himself master of it.

Much of the success of the pharmaceutical store will be dependent upon the discipline maintained among those to whom the details of the business are necessarily intrusted, and the difficulties surrounding the proper management of the business will increase as it extends and involves the employment of more numerous apprentices or other employees, unless the general duties of all are specifically laid down, and the particular duties of each well defined and insisted upon.

The rules which follow were prepared by my valued friend, the late Henry C. Blair, a man of many estimable traits of character and of high standing as a pharmacist; they were designed for a store employing three apprentices, and as originally prepared were so admirable that I have inserted them with but little alteration. Although, of course, they require modifications to suit the circumstances of different establishments, their general tenor is adapted to all, and the high tone of professional and moral rectitude they require renders them worthy the acceptance of every apprentice who would deserve the approval of his employer, and of every employer who desires the best interests of his apprentice.

RULES OF A PHARMACEUTICAL STORE.

General Regulations of the Store.

1. Business hours will include the time between breakfast and 6 o'clock P. M., except when special duty may require it otherwise.

During business hours all hands must be on their feet, and must be employed either in waiting on the counter or at some regular store duty.

2. As waiting on the counter is a duty which requires most knowledge and experience, the Senior apprentice must always serve where there is one customer; when two, the first Junior apprentice will assist, and when three the second Junior will aid.

The Senior apprentice must always take that part of the duty which requires most knowledge and skill. This order of duty must never be deviated from if circumstances will at all admit of it.

3. Never put up an article without you are certain it is right.

4. In every instance, customers must be waited on with promptitude, and in case one only is present and several articles are wanting, or a prescription, or in any instance where assistance will expedite, the first Junior, and the second, if necessary, will aid.

Every other duty must give way to that of waiting on the counter except when serious detriment would be the consequence.

5. Every person entering the store, whether pauper or president, infant or adult, white or colored, must be treated with courtesy and kindness.

6. Boisterous mirth and a sullen temper are to be equally avoided as productive of neither business nor business character. The acquisition of a uniformly cheerful temperament is an attainment worth far beyond the price it usually costs.

7. There are to be no masters and no servants. Each one is to feel conscious of the fact that the performance of the duties assigned to him are just as necessary and as important as what pertains to any other hand in the store. All useful employment is honorable. Indolence is a disgrace.

8. An afternoon of every week will be devoted to cleaning the store, in which all must share as occasion offers.

As neatness, order. cleanliness, and accuracy are necessary and not mere accomplishments in a Pharmacist, all are required to practise them constantly.

9. Every apprentice will be expected to become a graduate of the College of Pharmacy, and will be furnished with tickets for the lectures of the College and every opportunity for availing himself of the honor of the degree of that Institution.

To deserve this degree will require a severe economy of leisure hours, and their application to the study of those books which relate to the theoretical and practical knowledge necessary to make an accomplished Pharmacist.

10. Apprentices need but few social acquaintances, and they should be very select. While the occasional visit of a well-behaved

young friend will be countenanced, lounging in the store will not be tolerated.

11. Each apprentice will have at his disposal an afternoon and evening every week, and every other Sunday. The afternoon will comprise the time between 12 o'clock, at noon, and 6 o'clock P.M., and the evening between 6 o'clock P.M., and the closing of the store. These privileges will not be interfered with unnecessarily. A vacation of two weeks, every year, will be allowed each apprentice.

12. No apprentice residing in the house will be allowed to be absent at night after the closing of the store, without special permission.

13. It is not the wish of the proprietor of the store that any of his apprentices should extol an article beyond its merit to advance his pecuniary interest, or to say or do aught in the performance of his duty that he would not be willing that others should say or do to him under the same circumstances.

14. As all are presumed to be members of the proprietor's family, their intercourse will be characterized with the courtesy becoming young gentlemen.

No bond of apprenticeship will be required except the honor of the individual.

Should the party wishing to leave before the allotted time expires have a good reason for so doing, the proprietor will not probably object; and should his cause be a bad one and be persisted in, the proprietor will certainly not offer a hindrance to his going.

15. A cheerful compliance with the foregoing rules is confidently expected, and the repeated infraction of a known regulation of the store will be cause for a dismissal.

Specific Duties of the Senior Apprentice.

1. To see that the specific duties of his Juniors are promptly and well performed.

2. To wait on the counter in the morning before breakfast, that they may not be hindered in the performance of their duties.

3. In case of the absence of either of his Juniors, to take the place of his first Junior.

4. He is to take charge of the books.

5. To take knowledge of and properly note any articles that may be needed for the store, including goods to be purchased, and preparations to be made.

6. To see that the drawers, shelves, and cases are well supplied with such articles as are kept on hand in any quantity.

7. To keep a note-book of what is necessary to be done in the ordinary business of the store, and to designate employment for his Juniors.

8. In the absence of the Proprietor, to take entire charge of the store, and to be alone responsible for its business.

Specific Duties of the First Junior Apprentice.

1. It will be his duty to dust the counters and desks thoroughly every morning. This service must be performed before breakfast, and repeated as often through the day as necessary.
2. In case of the absence of the second Junior apprentice he is to perform his duties.
3. He is to paste the prescriptions in the book kept for that purpose or to file or copy them, once every week.
4. He will copy the bills into the bill-book once every week.
5. It will be his duty to keep the drawers well supplied with paper for wrapping purposes, including the various sizes of cut paper.
6. It will be his duty to clean the scales, large and small, once every week, and oftener, if necessary.

Specific Duties of the Second Junior Apprentice.

1. He is to open the store in the morning, make the fire, and attend to it through the day, sweep out the store, wash the mortars, etc., keep the mineral-water counter clean, and the syrup bottles filled. These duties are to be performed in part before breakfast.
2. It will be his duty to take entire charge of the labels, keeping a register of those needed, and having the drawers always well supplied with labels trimmed for use; also, to have the proper drawers well provided with clean vials, and with pill, powder, and ointment boxes.
3. It will be required of him to do such errands as the business of the store may demand, and to close the store at night.

APPENDIX.

ON THE MANAGEMENT OF A SICK CHAMBER.

The following hints on the management of the sick chamber are chiefly from the pen of a lady of intelligence and experience. Although addressed especially to nurses, they should be carefully studied by practitioners of medicine, upon whom the responsibility of giving direction to the conduct of the sick chamber mainly devolves.

Ventilation.

Few persons who are in the habit of visiting the sick can have failed to notice the great difference in the state of the air, in chambers where cleanliness and good management have been in exercise, and those wherein the value and importance of neatness and the careful admission of a free current of fresh air have been overlooked. If, then, temporary visitors are sensible of the difference, how much more deeply interested must the suffering patient be in the attainment of a free and healthy atmosphere.

Cleanliness.

Since it is often difficult to get a sick room swept, it may be desirable, if it can be done unheard, to get at least a part of the carpeting away now and then, that it may be well shaken. A few tea-leaves may be thrown over a part of the room at a time, and very quietly taken up with a hand-brush. And in those cases which are not at all critical, and where anything damp can be admitted into the room with impunity, a mop, which, after being dipped in water, has been *well trundled*, may be just used for a few minutes to remove the flue from under the bed; or it may be very carefully passed over a carpet, if nailed down.

Change of Posture, Arrangement of the Bed, etc.

It is scarcely to be believed, until experienced, the relief from suffering which a change of posture produces; neither is it generally thought of, how much alleviation could be attained in many instances, even by the fresh cording of the sacking, with special attention to a level position; a hard bed or mattress, for a suffering invalid, is not recommended, but an arrangement for a level position will often afford great comfort. The sacking first tightly corded (but splines instead of sacking are much better), then a straw palliasse, which, if not newly made, ought to be raised by a fresh supply of straw in the *middle*, where a heavy pressure may have rendered it uneven; over this, a good feather bed, which ought to be gently pressed and made level, then a mattress, composed first of a thick bed of horsehair, and well overlaid with excellent long wool; it ought to have room for the bed-post at each of its four corners, so that it

may not only be turned *daily* from *side* to *side*, but also from the *head* to the *feet;* indeed, it is better, as it regards even the straw palliasse, to adopt such a plan as may admit of the turning of it, and, as it is heavy and unyielding, it is better to have the corners cut out at each of its two parts, making a small oblong of the same material and height, to tie on in the middle; or an inconvenient aperture might be made there. The proper arrangement of pillows is of no small importance, and in cases of fever a change of pillows is desirable; this, too, furnishes an opportunity for putting on fresh pillow-cases.

Make circular cushions, in the form of a ring, of old linen and stuffed with bran. A patient, obliged by disease to lie continually on one side, will find great relief to the *ear* or prominent *bones* by these "ring-cushions."

Cleanliness of the Person.

Wash and refresh the patient whenever suitable, also brush the teeth and hair—the latter may be bathed with bay rum, lavender water, cologne, etc. All this, subject to the strength of the patient, and the permission of the medical attendant. It may be deemed needless to give the above hint, but it cannot be doubted that by far too many lose the full enjoyment and benefit of a thorough attention to the cleanliness of the person.

Washing Cups and Glasses.

An appropriate table, not liable to injury, is a great convenience in a sick room; so is a small wicker basket, with compartments to hold the different bottles of medicine and articles of diet. It may be also useful to have a couple of baskets with compartments to hold glasses or cups, one of these being sent out with the things which need washing, and always ready to be exchanged.

Preservation of Ice.

In our hot summers, one of the greatest practical difficulties in nursing arises from the spoiling of articles of food prepared for the sick or for infants, and which must be kept at hand for use, especially during the night; it is also a desideratum to have ice at hand for cooling drinks, etc. A good contrivance for this purpose is made by I. S. Williams, of Philadelphia. It consists of a double can, the inside of galvanized iron, and the outside of tin, with an air-chamber between; near the bottom is a diaphragm, below which a piece of ice is placed, and a bowl or other utensil is arranged to set upon this, and to be conveniently lifted out by a wire handle. This answers a good purpose.

Change of Linen.

A frequent change of linen is a great comfort and benefit, in most cases. Let the bed linen be frequently changed (when suitable), and, in serious cases of fever, it may be useful to untuck the bottom of the bed and gently shake the upper clothes, so as to let the warm and impure air pass away. Let the sheets and blankets be of full size, that they may be *tucked thoroughly* under the mattress, or *whatever* is at the top. It is a comfort to the patient to have all straight and smooth under him, and nurses are recommended to attend to this more than once in a day.

Change of Room.

In some particular cases of long and depressing sickness, a change of room, conducted with great prudence, may be found a powerful aid towards recovery.

On removing the patient into another room this ought, if in the spring, autumn, or winter, and even in part of the summer, to be very carefully prepared with not only a good fire, but an attention to the doors and windows, that all be shut, and the temperature brought to that of the room about to be left. When at any time a patient's room is to be aired, the curtains should be drawn closely round the bed. Just raising the window for an inch or two will be useful, if it be for a short time; but, rather than run any risk to the invalid, throw on an additional blanket.

Avoidance of Noise and Excitement.

Much conversation is often injurious, and WHISPERING OFFENSIVE. Place a pan covered with sand underneath the fire to receive the cinders, and have a second ready to make an exchange when this is taken up. Let the number of the visitors in the room be chiefly confined to those whose services are effective, and let all wear shoes with list or cloth soles or slippers. The rustling of silk gowns may prove an annoyance to those who are in a very weak state, also the rattling of cups, stirring the fire, etc. Those only who have suffered from severe illness can well judge of the importance of preserving a quiet mental atmosphere; *how little* those suffering with languor and pain are competent to sustain the pressure which a tale of woe may impose. The subject of conversation should be much guarded, while a cheerful demeanor, and innocently lively manner, may help to assuage or lessen the sense of distress.

Sitting up.

Let the linen-horse be timely placed before the fire, with every article likely to be needed; and, if the clothes are to be put on and washing included, let the hot water and all be ready, so as to avoid the least bustle. Spread a blanket on the floor for the patient to walk over.

Neatness.

An increased delicacy of the stomach and sense of nicety are the concomitants of disease, and, therefore, the nurse and all around should be particularly careful, not only as to the neatness of their own persons, but that every dose of medicine, and all food, be presented in the most tempting, clean, and delicate way. To promote this, it may be desirable, in long illnesses, to have at hand a variety of small vessels of different sizes.

Protection from Light, and from the Blaze of Fire and Candle.

Diseases are so variable in their effects, that no minute plan is suggested for any particular case. However cheering the light of the sun in many instances, there are affections where a judicious nurse would be called upon to screen the invalid from the blaze of day. She should remember that, by a little arrangement of shutters and curtains, a room may still be made cheerful by a sort of subdued light; while in some distressing affections of the head, etc., from severe fever, the patient can hardly be too much indulged by the darkening of the room. In such a case, the blaze of the fire must greatly augment suffering. Screens ought to be at hand, as well for that as for the candle. The nursery lamp will be

found useful not only to keep a screened light at hand, but also for warming soups, beef-tea, or other articles of nourishment.

Important that the Nurse be taken care of.

The nurse who is much engaged in night service ought to be carefully spared in the day; she must have rest, or she cannot long hold out. When sitting up at night, some strong coffee or tea, ready made, should be prepared, that it may be warmed and taken without the least disturbance to the sick person. Some nurses make a great noise with the clattering of tea-things, which ought to be avoided.

Gentleness and Kindness.

All who surround the patient should be kind, gentle, and patient; not a sound of harshness or evidence of discord should reach his ear. Any discussion as to whether *this* or *that* be best, should be avoided in his presence. Some persons, with the greatest desire to do right, do *too much*, and, without intending it, interrupt a sufferer by unimportant questions and inquiries, and by moving about the room, when they would often do a much greater service by sitting quietly beside the bed, attending to requests emanating from the patient, whose feelings and preferences should always be consulted and accorded with, if not interfering with medical directions, or being in themselves palpably improper and injurious. There is, perhaps, scarcely any situation in which the call is greater upon the Christian virtues than in a sick chamber, for it very often happens that disease makes a great impression upon the nervous system, and pain and suffering disturb the accustomed placidity of the invalid, who, with every desire to bend patiently under the affliction, may now and then seem scarcely able to appreciate the kindest efforts to minister to his need.

To avoid Unreasonable Interruption.

Particularly guard the sufferer who has just fallen asleep. The person having the chief responsibility should be instructed to pass the feathery end of a quill through the keyhole, whenever sleep or any other cause renders interruption unsuitable; and this sign should be strictly regarded. It is far better than risking disturbance to the patient by trying a locked door. Tie the quill to the handle of the door, that it be not lost.

A Dying-bed.

Let no one annoy the patient by sitting on the bed, or indulging in earnest expressions of surprise or grief. All around ought to be still; no calling out, "Oh, he's dying," etc.

It should be carefully ascertained that the body be placed in the easiest posture. The bed-curtains should be, in most cases, gently undrawn, and the least possible interruption given to the admission of fresh air. All but those who are fanning the patient, or perhaps moistening the parched mouth or otherwise promoting his comfort, should be careful to keep at a distance from the bed, and be quietly seated. It is believed that few can tell the suffering often inflicted on the dying by the thoughtless bustle of attendants and *even friends*. The speaking in a loud tone, the setting down of even a glass or vial, may often cause distress. No sound should disturb, beyond an occasional and necessary whisper, the solemn period of dissolution.

Preparations used as Articles of Diet for the Sick and Convalescent.

Arrowroot Pap.

Take of Arrowroot, one large tablespoonful.
Water, one pint.

First mix the arrowroot well into a paste with a little of the cold water; bring the remainder of the water to a boiling heat; then stir in the arrowroot; let it boil a few minutes; sweeten it with loaf sugar.

The preparation of arrowroot pap with milk renders it richer and more nutritious, though sometimes not allowable.

The application of direct heat to preparations of this description, always involves the danger of scorching them, and the intervention of a water-bath is found to prevent the accident. The apparatus known as Hecker's farina boiler, figured on page 106, is made for the purpose, and is a useful utensil in any family.

Arrowroot Pap, with Milk.

Put in a saucepan, to boil, one pint of milk; stir very smoothly, into a cup of cold milk, a dessertspoonful of arrowroot; when the milk boils, stir in the arrowroot; continue to stir until it is cooked, which will be in five or ten minutes; then remove it from the fire, and sweeten to the taste.

Toast Water.

Cut a slice of stale bread half an inch thick, a finger length long; cut off the crust, and toast it quite brown, but not scorched; while hot, put it into a small pitcher; pour over half a pint of boiling water; cover it tightly and when cool pour it off and strain.

Mulled Wine.

Put cinnamon or allspice (to the taste) into a cup of hot water to steep; add three eggs, well beaten, with sugar; heat to a boil a pint of wine; then put in the spice and eggs, while boiling, and stir them until done, which will be in three minutes.

Jelly for Invalids.

Cut a penny roll into thin slices; toast them to a light brown; then boil gently in a quart of water until it jellies; strain it upon a few shavings of lemon-peel; sweeten, and add, if liked, a little wine and nutmeg.

Eggnog.

Take the yelks of eight eggs; beat them with six large spoonfuls of pulverized loaf sugar; when this is a cream, add the third part of a nutmeg, grated; into this stir one tumblerful of good brandy, and one wineglass of good Madeira wine; mix them well together; have ready the whites of the eggs, beaten to a stiff froth, and beat them into the mixture; when all are well mixed, add three pints of rich milk.

Panada.

Cut two slices of stale bread half an inch in thickness; cut off the crust; toast them a nice brown; cut them into squares of two inches in size; lay them in a bowl, sprinkle a little salt over them, and pour on a pint of boiling water; grate a little nutmeg.

Tapioca.

Soak two tablespoonfuls of very clean tapioca in two teacups of cold water over night; in the morning, add a little salt, one pint of milk, or water if milk cannot be taken; simmer it until quite soft; stir well while cooling; when done, pour into a bowl, and, if allowed, add sugar, a spoonful of wine, and a little nutmeg.

Rice Jelly.

Take of rice, one-quarter of a pound; white sugar, half a pound; water, one quart. Boil these well together, carefully stirring them till the whole becomes a glutinous mass. Strain off into a dish or form. When cool, it is fit for use. This preparation may be flavored with rose-water, orange-flower water, or lemon-juice, as may best suit the palate of the patient, or as directed by the physician.

Iceland Moss Jelly.

Take of Iceland moss, two ounces; water, one quart. First wash the moss in some cold water; then put it into the quart of water, and boil slowly till very thick, adding white sugar till sufficiently sweet, then strain through a cloth. When cold, it will be fit for use, and may be eaten with spices, if allowed. Irish moss jelly may be prepared in the same way.

Sago Jelly.

Take four tablespoonfuls of sago, one quart of water, juice and rind of one lemon; sweeten to the taste. Mix all the ingredients well together; let it stand for half an hour; then put it on to boil, till the particles are entirely dissolved; it should be constantly stirred. It is very much improved by the addition of wine.

Calves' Feet Jelly.

Boil two calves' feet in one gallon of water, down to a quart; then strain it, and, when cold, skim off all the fat; take up all the clear jelly. Put the jelly into a saucepan, with a pint of wine, half a pound of loaf sugar, the juice of four lemons, the white of six or eight eggs beaten into a froth. Mix all well together. Set the saucepan upon a clear fire, and stir the jelly till it boils. When it has boiled ten minutes, pour it through a flannel bag till it runs clear.

Essence of Beef.

This is prepared from lean meat, by cutting it into small pieces, adding a little salt, then introducing into a wide-mouth bottle, corked tightly, and heating it gradually by immersing in a kettle of water, to which heat is applied till it boils. After a few hours digesting in this way, the juice is drawn off, and constitutes the most concentrated form of nourishment.

Beef Tea.

Take of lean beef one-quarter of a pound, a pint and a half of water, salt sufficient to season it. When it begins to boil, skim it five minutes; then add two blades of mace; continue the boiling ten minutes longer, when it will be ready for use. (See *Liebig's Broth*, page 366.)

Chicken Broth.

Clean half a chicken; on it pour one quart of cold water, and a little salt; put in a spoonful of rice; boil two hours very slowly, and tightly covered; skim it well; just before using it, put in a little chopped parsley.

Chicken Jelly.

Cut up a chicken; put it into a stone jar; break all the bones; cover very closely; set the jar into boiling water; keep it boiling three hours and a half; strain off the liquor; season with salt and a very little mace.

Rice Jelly.

Boil a quarter of a pound of the best rice flour, with half a pound of loaf sugar, in a quart of water, until the whole becomes one glutinous mass; strain off the jelly, and let it stand to cool. This is nutritious and light.

Slippery Elm Bark Jelly.

Four large spoonfuls of the bark, chipped; pour on it one quart of cold water; let it stand all night; stir it, and let it settle; the next morning pour off the water; slice the rind of a lemon very thinly, and, with the juice, put it in the water strained; let it simmer, very gently, fifteen minutes; then sweeten, and pour in a mould to cool and harden; take out the rind before putting it in the mould.

Wine Whey.

Boil a pint of new milk; add to it a glass or two of white wine; put it on the fire until it just boils again; then set it aside till the curd settles; pour off the clean whey; sweeten to the taste; cider serves as well as wine to curdle milk, if it is good country cider.

Corn Meal, or Oatmeal Gruel.

Put in a clean saucepan one pint of water to boil; when boiling, mix of oatmeal two large spoonfuls, in a half pint of milk, and a little salt; stir this into the boiling water; stir it well; let it simmer thirty minutes; then strain through a hair-sieve; if the patient can bear it, stir in a large spoonful of the best brandy after it is strained and sweetened, and add a little grated nutmeg; if corn meal is used, stir the dry corn meal into the boiling water; two large spoonfuls to a pint of boiling water, and a half pint of new milk; season as the other.

Vegetable Soup.

Take two white potatoes, one onion, a piece of well-baked bread. Put these into a clean stewpan, in one quart of water; boil them down to a pint; throw into the vessel some parsley or celery; cover the vessel closely; remove it from the fire, and allow the herbs to steep, while the liquor is cooling, under cover; season to the taste.

Castillon's Powders.

Take of Powdered tragacanth,
Powdered sago,
Powdered salep,
Sugar, each, one ounce.
Prepared oyster-shell, two drachms.

Mix them thoroughly, and fold into papers containing each one drachm.

Directions.—Mix a powder with four tablespoonfuls of cold milk in a bowl. Then transfer it to a milk-pan, and while stirring, pour upon it gradually one pint of boiling milk, and boil for a quarter of an hour. Sugar may be added, to the taste.

SMALL OUTFIT

FOR A PHYSICIAN COMMENCING PRACTICE IN THE COUNTRY.

The following list of Medicines and Preparations may be regarded as the least on which a physician who is obliged to dispense his own prescriptions can commence practice. It is intended that the Medicines and Preparations should be put up in substantial Ground-Stoppered Bottles.

8 oz. Acacia.
½ pint Acidum aceticum.
3 oz. " citricum.
2 oz. " muriaticum.
3 oz. " nitricum.
½ pint " sulph. arom.
1 oz. " tannicum.
2 pints Alcohol.
4 oz. Alumen.
4 oz. Ammonii carbonas.
4 oz. " murias.
1 pint " Aqua.
½ pint Ammoniæ spiritus arom.
1 oz. Antim. et potass. tart.
¼ oz. Argenti nitras. cryst. } ¼ oz. " " fusa. }
4 oz. Assafœtida.
8 oz. Camphora.
2 oz. Cardamomum.
4 oz. Ceratum cantharidis.
3 oz. Chloroformum.
2 oz. Collodium.
½ pint Copaiba.
1 oz. Creasotum.
6 oz. Creta præparata, or } 4 oz. Calcis carb. præcip. }
4 oz. Cupri sulphas.
2 oz. Ergota (whole or powdered).
½ pint Æther (Letheon).
1 oz. Extractum aconiti
1 oz. Extractum belladonnæ.
1 oz. Extractum colocynth comp. pulv.
2 oz. Extractum gentianæ.
1 oz. Extractum hyoscyami.
1 oz. Extractum jalapæ pulveris.
8 oz. Extractum valerianæ fluid.
8 oz. Ferri subcarbonas.
1 oz. Ferrum redactum.
½ pint Ferri chloridi tinct.
4 oz. Fœniculum.
8 oz. Gentiana contus.
4 oz. Hydrarg. massa.
4 oz. " chlorid. mit.
2 oz. " oxid. rub.
2 oz. " cum creta.
1 oz. Iodinium.
½ pint Liquor hydrarg. et arsen. iodid.
½ pint Liquor potassii arsenitis.
3 oz. Magnesia.
2 ℔ " sulphas.
⅓ oz. Morphiæ sulphas.
2 oz. Myrrha.
½ oz. Oleum cinnamomi.
½ oz. " limonis.
½ oz. " menthæ pip
1 pint " ricini.
1 pint " terebinthinæ.
½ oz. " tiglii.
6 oz. Plumbi acetas.
3 oz. Potassii bicarb.
12 oz. " bitartras.
3 oz. " citras.
4 oz. " chloras.
6 oz. " nitras.
2 oz. Potassii iodidum.
6 oz. Pulvis acaciæ.
3 oz. " aloes, Soc.
4 oz. Pulvis extract. glycyrrhizæ.
1 oz. Pulvis gambogiæ.
1 oz. " ipecacuanhæ
3 oz. Pulvis ipecacuanhæ comp.
1 oz. Pulvis opii.
4 oz. " rhei (E. Ind.).
2 oz. " scillæ.
6 oz. " sodæ boratis.
8 oz. Quassia.
1 oz. Quiniæ sulphas.
4 oz. Rheum.
6 oz. Sapo (Castil. alb.).
4 oz. Senega.
4 oz. Serpentaria.
1 ℔ Sodii bicarb.
8 oz. Sulphur sublim.
1 pint Spiritus ætheris nit.
½ pint Spirit. ætheris comp.
1 pint Spiritus lavandulæ comp.
½ pint Syrupus ipecacuanhæ.
½ pint Syrupus scillæ.
½ pint " rhei arom.
1 pint Tinctura cinchonæ comp.
1 pint Tinctura opii.
1 pint " " camph.
4 oz. Unguentum hydrarg. (½ mercury).
4 oz. Unguentum hydrarg. nitratis.
¼ pint Vin. colchici rad.
2 oz. Zinci oxidum.
6 oz. " sulphas.

IMPLEMENTS.

Scales and weights.
f℥iv. Grad. Measure.
1 Mortar and pestle.
1 Pill tile.
2 Spatulas.

½ gross vials.
German flint.

½ doz. f℥viij.
¼ doz. f℥vj.
1¼ doz. f℥iv.
1½ doz. f℥ij.
1½ doz. f℥i.
1 doz. f℥ss.

1 Funnel.
1 qr. Wrapping & filtering paper.
1 gross Vial corks.
2 papers Pill boxes.
2 yards Adhesive plaster in tin case.

This Catalogue is retained as a guide to the Practitioner of Medicine who intends dispensing his own prescriptions, and was formerly termed

A MORE COMPLETE OUTFIT.

But the great changes which have taken place, from various causes, render the value quite different and constantly fluctuating.

1 ℔ Acacia.
½ ℔ " pulvis.
1 pint Alcohol.
½ pint Acidum aceticum.
1 oz. " benzoicum.
4 oz. " citricum.
1 oz. " hydroc. dil.
4 oz. " muriaticum.
4 oz. " nitricum.
½ pint " sulph. arom.
1 oz. " tannicum.
4 oz. Aloe pulvis (Soc.).
8 oz. Alumen.
4 oz. Ammonii carbonas.
1 pint " aqua.
4 oz. " murias.
½ pint " spt. arom.
4 oz. Antim. et potass. tart.
½ oz. Argenti nitras. cryst.
½ oz. " " fusa.
4 oz. Assafœtida.
1 oz. Bismuthi subnitras.
8 oz. Camphora.
4 oz. Cardamomum
6 oz. Creta præparata, or
4 oz. Calc. carb. præcip.
6 oz. Chloroformum.
8 oz. Cinchona rub. pulv.
1 oz. Cinchonæ sulphas.
1 oz. Creasotum.
8 oz. Ceratum cantharidis.
8 oz. " resinæ.
8 oz. " simplex.
½ pint Copaiba.
1 ℔ Cubebæ pulv.
2 oz. Collodium.
1 oz. " cantharidal.
4 oz. Ergota.
1 ℔ Æther.
1 oz. Extract. aconiti.
1 oz. " belladonnæ.
1 oz. " conii.
1 oz. " hyoscyami.
2 oz. " coloc. c. pulv.
2 oz. " jalapæ pulv.
1 oz. " nucis vomicæ.
1 oz. " quassiæ.
8 oz. " taraxaci.
1 ℔ " sennæ fluid.
1 ℔ " spigel. et sennæ fluidum.
½ pint Ext. valerianæ fluid.
4 oz. Ferri carbon. massa (Vallet).
8 oz. Ferri subcarb.
1 oz. " citras.
½ pint " sesquisulph. sol. (with directions for preparing hydrated peroxide when required).
1 oz. Ferrum redactum.
8 oz. Fœniculum.
1 oz. Gambogiæ pulv.
1 ℔ Gentianæ contus.
4 oz. Glycyrrhizæ ext. pulv.
4 oz. " rad. "
2 oz. Glycerinum.
½ ℔ Hydrarg. massa.
½ ℔ " chlor. mit.
1 oz. " cum creta.
2 oz. " oxid. rub.
1 oz. " iodidum.
1 oz. Iodinium.
4 oz. Ipecacuanhæ pulvis.
4 oz. Jalapæ pulvis.
8 oz. Juniperus.
2 oz. Kino.
4 oz. Liquor iodinii comp.
½ pint " hyd. et ars. iod.
½ pint " potass. arsenit.
1 ℔ bot. Magnesia.
½ ℔ Magnesii carb.
5 ℔ " sulphas.
6 oz. Manna.
⅛ oz. Morphiæ sulphas.
⅛ oz. " acetas.
⅛ oz. " murias.
4 oz. Myrrha.
1 oz. Oleum anisi.
1 oz. " cinnamomi.
1 oz. " limonis.
1 oz. " menthæ pip.
1 bot. " olivæ.
1 pint " ricini.
1 pint " terebinthinæ.
1 oz. " tiglii.
2 oz. Opii pulvis.
8 oz. Plumbi acetas.
2 oz. " carbonas.
2 oz. Potassa (caustic).
4 oz. Potassii bicarbonas.
2 ℔ " bitartras.
4 oz. Potassii citras.
4 oz. " nitras.
8 oz. " sulphas.
2 oz. " iodidum.
3 oz. Pulvis ipecac. comp.
8 oz. Quassia.
1 oz. Quiniæ sulphas
6 oz. Rheum (E. Ind.).
4 oz. Rhei pulvis.
4 oz. Sapo (Castil.).
8 oz. Sarsaparilla.
2 oz. Scillæ pulv.
8 oz. Senna (Alex.).
8 oz. Senega.
8 oz. Serpentaria.
1½ ℔ Sodii bicarbonas.
4 oz. " borat. pulv.
8 oz. " et potass. tart.
4 oz. " phosphas.
8 oz. Spigelia.
⅛ oz. Strychnia.
4 oz. Sulphur præcip.
¾ ℔ " sublim.
½ pint Spirit. ammon. arom.
½ pint " ætheris comp.
1 pint " " nitrici.
½ pint " lavand. comp.
½ pint Syrup. ipecacuanhæ.
½ pint Syrupus ferri iod.
1 pint " pruni virg.
1 pint " rhei aromat.
1 pint " scillæ.
½ pint " senegæ.
4 oz. Tinctura aconiti rad.
1 pint " cinchonæ c.
½ pint " digitalis.
½ pint " ferri chloridi.
1 pint " opii.
1 pint " " camph.
1 pint " zingiberis.
½ ℔ Ung. hydrarg.
½ ℔ " " nitratis.
½ ℔ " simplex.
½ ℔ Uva ursi.
½ ℔ Valeriana.
1 pint Vinum antimonii.
½ pint " ergotæ.
½ pint " colchici rad.
⅛ oz. Veratria.
4 oz. Zinci oxidum.
8 oz. " sulphas.

RECIPES FOR SOME OF THE MORE IMPORTANT POPULAR MEDICINES.

Dalby's Carminative.

The published recipes for this, as found in the formularies, are not those used generally by druggists. Some of the ingredients in the original recipes are procurable with difficulty, and add so much to the expense of the preparation, that by common consent they are left out. The formula, as given by the College of Pharmacy, is nearly identical with that which I have used for a number of years, and I give it below.

		Parts.
Take of Carbonate of magnesium	℥vj	75.
Carbonate of potassium	ʒij	3.125.
Sugar	℥xvj	200.
Tincture of opium	f ʒiij	op. 37.5.
Water	Ov	1000.
Oils of caraway,		
Fennel,		
Peppermint, each	♏x.	

(To the above may be added—

French brandy	f ʒiv.
Prepared chalk	ʒij.)

Triturate together the essential oils, sugar, magnesium (and prepared chalk, if added), then add the water, and afterwards the remainder.

Dalby's carminative contains one grain of opium to about an ounce.

Dewees' Carminative.

Take of Carbonate of magnesium	℥iss.
Sugar	℥iij.
Tincture of assafœtida	f ℥iij.
Tincture of opium	f ℥j.
Water	Oiss.

Triturate together until they are mixed.

Bateman's Pectoral Drops.

Take of Diluted alcohol	Cong. j	1000.
Red sanders,* rasped	℥ss	31.25.

Digest for twenty-four hours, filter, and add—

Opium, in powder	℥ss	31.25.
Catechu, in powder	℥ss	31.25.
Camphor	℥ss	31.25.
Oil of anise	f ʒj	7.81.

Digest for ten days.

This preparation contains about one grain each of opium, catechu, and camphor, to the f ℥ss, corresponding in strength with tinctura opii camphorata, *U. S. P.*

Godfrey's Cordial.

			Parts.
Take of Tincture of opium	f ℥vj	op. 34.5	1000.
Molasses (sugar house)	Oiv	367.8	
Alcohol	f ℥viij	46.	
Water	Oviss	551.7	
Carbonate of potassium	℥v		57.5.
Oil of sassafras	f ʒj		11.

* Superseded by Caramel ʒiij.

Dissolve the carbonate of potassium in the water, add the molasses, and heat over a gentle fire till they simmer, remove the scum which rises, and add the laudanum and oil of sassafras, having previously mixed them well together.

This preparation contains a little over one grain of opium to the ounce, and is about half the strength of the foregoing.

Balsam of Honey.

Take of	Balsam Tolu	℥j.
	Benzoic acid	ʒiss.
	Honey	℥vj.
	Opium (powd.)	ʒij.
	Cochineal	ʒj.
	French brandy	Oiij.

Mix, and digest together for a few days, then filter.

Composition Powders. (*Thompsonian.*)

Take of	Powdered bayberry root	℔j.
	Powdered ginger	℔ss.
	Powdered cayenne	℥j.
	Powdered cloves	ʒj.

Mix, by passing through a sieve.

No. 6—Hot Drops. (*Thompsonian.*)

Take of	Capsicum (powd.)	ʒj.
	Myrrh (contus.)	ʒiv.
	Alcohol	Oij.

Displace.

Haarlem Oil.

Take of	Ol. Sulphurat.	Oiij.
	Petrol. Barbadens	Oj.
	Ol. succin (crude)	Oiss.
	Ol. terebinth.	Oviij.
	Ol. lini	Oiv.

Mix.

Turlington's Balsam of Life.

The officinal tinctura benzoini composita is sold under this name, but the druggists who put it up in the peculiar and very odd-shaped vials, in which it was originally vended in wrappers descriptive of its virtues, use various recipes for making it. The following is that published by the Philadelphia College of Pharmacy, and used in many of the best establishments. The original recipe for this, as filed in the office of rolls in London, contained twenty-eight ingredients.

Take of	Alcohol	Oiv.
	Benzoin	℥vj.
	Liquid storax	ʒij.
	Socotrine aloes	ʒss.
	Peruvian balsam	ʒj.
	Myrrh	ʒss.
	Angelica	ʒij.
	Balsam Tolu	ʒij.
	Extract of liquorice	ʒij.

Digest for ten days and strain.

Opodeldoc.

Take of Common soap (sliced), three ounces.
Camphor, an ounce.
Oil of rosemary,
Oil of origanum, each, a fluidrachm.
Alcohol, a pint.

Digest the soap, by means of a sand-bath, with the alcohol till it is dissolved, then add the camphor and oils, and when they are dissolved pour the liquid into wide-mouth two-ounce bottles.

British Oil.

Take of Oil of turpentine	f℥iv.
Oil of flaxseed	Oiij.
Oil of amber	Oj.
Oil of juniper	f℥ss.
Petroleum (Barbadoes)	℥ij.
Petroleum (American)	℥ij.

Mix them well together.

Whitehead's Essence of Mustard.

Take of Ol. terebinth.	Oxij.
Camphoræ	1¼ ℔. com.
Ol. succin. rectif.	f℥iv.
Sem. sinapis, pulv. (Flava)	16 oz. com.

Digest for seven days, filter, and add—

Tr. curcuma	q. s.—Add color.

Hooper's Female Pills.

		Parts.
Take of Aloes	℥viij	400.
Dried sulphate of iron	℥ij ℥iss.	200.
or Crystallized sulphate of iron	℥iv	
Extract of black hellebore	℥ij	100.
Myrrh	℥ij	100.
Soap	℥ij	100.
Powdered canella	℥j	50.
Powdered ginger	℥j	50.
		1000.

Beat them well together into a mass with syrup, or water, and divide into pills, each containing two and a half grains.

Richards' Chalk Mixture.

Take of Precip. carbonate of calcium, Sugar, of each	℥j.
Comp. spt. lavender, Tinct. kino, of each	f℥j.
Essence of cinnamon	15 drops.
Water	f℥iij.
Tincture of opium	f℥j.

Mix.

Marshall's Pills.

Take of Comp. extract of colocynth,
Mercurial mass,
Powdered aloes,
Powdered Castile soap,
Powdered rhubarb, of each . . . . . 1 drachm.

Make into five-grain pills.

Anderson's Scots' Pills.

		Parts.
Take of Aloes	℥xxiv.	787.
Soap	℥iv.	131.
Colocynth	℥j.	33.
Gamboge	℥j.	33.
Oil of anise	f℥ss.	16.
		1000.

Let the aloes, colocynth, and gamboge be reduced to a very fine powder, then beat them and the soap with water into a mass of a proper consistence to divide into pills, each containing three grains.

*Worm Tea.**

Take of Senna,
Manna,
Spigelia, of each . . . . . ℥ss.
Fennel seed . . . . . ℥j.
Worm seed . . . . . ℥ss.
Savine . . . . . ℈ij.
Bitartrate of potassium . . . . . ℈ij.

Make into one package.

Directions.—Pour on to this a quart of boiling water, and let it digest for ten or fifteen minutes; of the clear liquor sweetened, give to children two years old and upwards a small teacupful *warm*, morning, noon, and night, on an empty stomach. It may be given three or four days successively, if necessary.

Ginger Beer.

Take of Race ginger (bruised) . . . . . Four ounces.
Bitartrate of potassium . . . . . Three ounces.

Mix them.

Directions.—Add to these ingredients five pounds of loaf sugar, two lemons (sliced), and five gallons of boiling water. Let it stand twelve hours; then add a teacupful of yeast to the mixture, and bottle immediately and securely. In a day or two it will be ready for use.

Pipsissewa Beer.

The virtues of this excellent alterative diuretic are obtained in an agreeable form, by the following process:—

Take of Pipsissewa (chimaphila, *U. S. P.*) . . Six ounces.
Water . . . . . One gallon.

* See page 542.

Boil, strain, and add—

Brown sugar	One pound.
Powdered ginger	One-half ounce.
Yeast	A sufficient quantity.

Set it aside till fermentation has commenced; then bottle it for use. Dose, a small tumblerful three or four times a day.

In the same way, sarsaparilla, sassafras, uva ursi, and other medicinal substances, may be made into *Cerevisiæ*, or beers.

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